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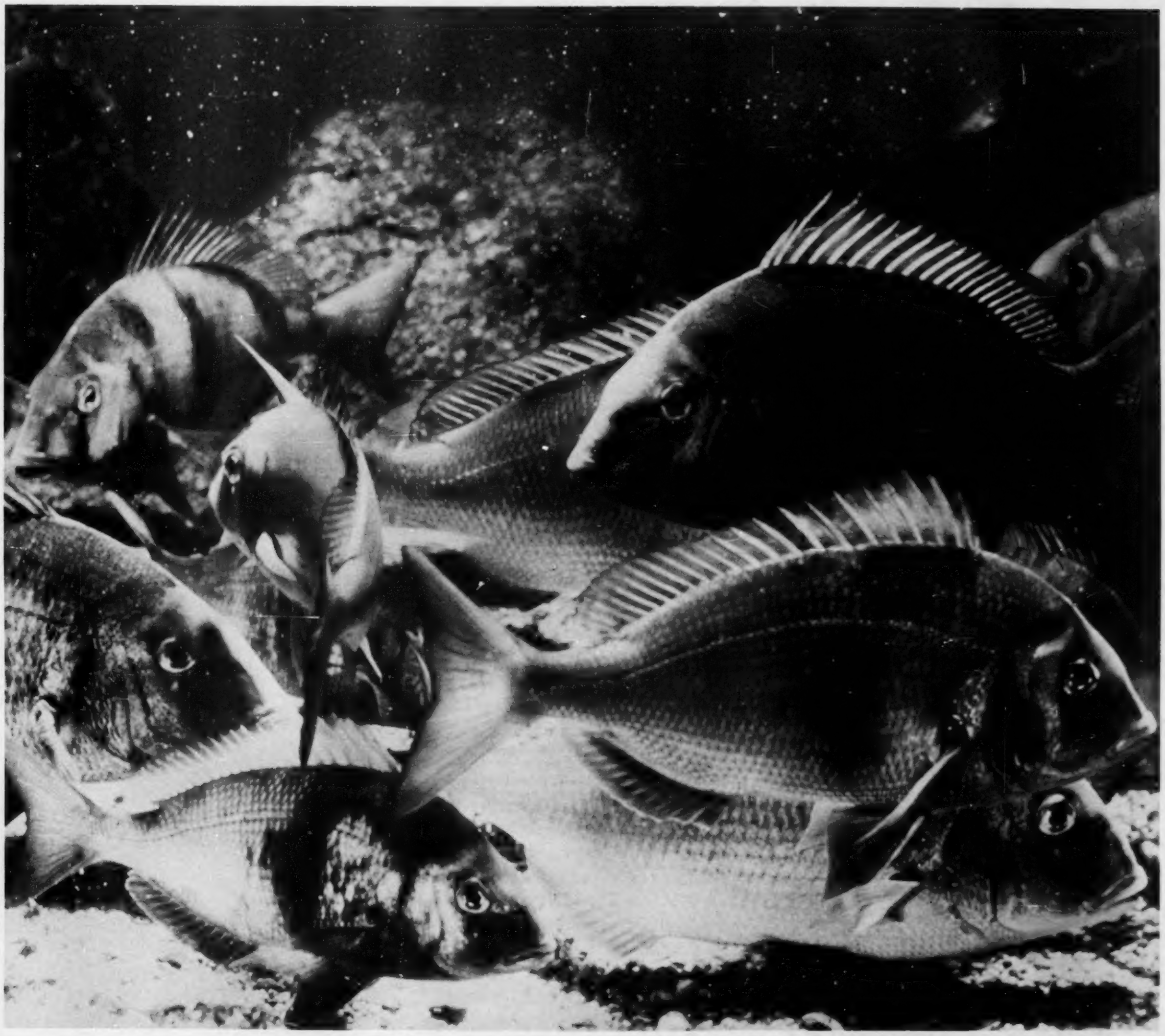

Marine Fisheries Review

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MFR PAPER 1177

Pilot SST mapping flights helped locate coastal coho salmon stocks 92.7 percent of the time in 42°-56°F water.

A System for Monitoring the Location of Harvestable Coho Salmon Stocks

DAVID J. WRIGHT, BRUCE M. WOODWORTH, and JAMES J. O'BRIEN

*ABSTRACT—During the summer of 1973, a pilot program was undertaken to test a system for monitoring the location of environmental factors favorable to coho salmon (*Oncorhynchus kisutch*) fishing and advising fishers of these locations. The operational system was successfully tested and proved to be effective, in both a subjective and statistical sense. The pilot program was operated off the Oregon coast from Cape Lookout south to Seal Rock from 15 June to 16 August. Primary users of the system were commercial and recreational fishers, including sport charter boat operators, with access to the ports of Newport and Depoe Bay. In the northern part of the test area, the "through-the-surf" dory fishery at Pacific City participated. In the study area, the coho salmon is a significant economic factor and was estimated to have an average impact on the order of $8,000,000 per year. This impact is estimated to be about equally divided between the commercial and sport fisheries. The coho salmon project involved the use of an aircraft mounted radiation thermometer to produce a daily sea surface temperature map over a finite offshore coastal area. Using the sea surface temperature map, along with other meteorological and oceanographic inputs, a daily forecast was produced to predict the location of environmental factors favorable to coho salmon. This paper describes the details of the system and presents an initial evaluation of system effectiveness.*

FACTORS WHICH LED TO THE PILOT STUDY

The scientific basis for the system was a result of Coastal Upwelling Experiment-Phase I (CUE-I) held off the central Oregon coast during the summer of 1972. During CUE-I, a large-scale physical oceanographic experiment, a research aircraft from the National Center for Atmospheric Research, Boulder, Colo., was used to map sea surface temperature (SST) with a remote sensing precision radiation thermometer. This mapping effort, coupled with a reasonably comprehensive understanding of the offshore circulation pattern and the effect of the rapidly changing wind field (O'Brien and Tamura, 1972), indicated a predictive capability was possible for the three-dimensional temperature field in the offshore area.

It has been hypothesized that the coho or silver salmon, *Oncorhynchus kisutch*, prefer a rather narrow temperature range, as do other species of fish. For coho salmon this range is estimated to be between 52° and 56°F (Godfrey, 1965; and Fisher, 1972). A predictive capability for the area wherein these temperatures would occur was thought to be of significant value to the coho salmon fishery.

The overall objective of the coho salmon project was to study the application of remote sensing techniques for the benefit of the central Oregon offshore coho salmon fishery. Substantively, this overall objective included the development and testing of the operational system and the forecast distribution system. To determine its economic value the pilot program also provided for a complete analysis of system effectiveness.

In designing the system, the previous experience of those involved in using SST maps to assist fishers was taken into account. This included reviews in techniques used in the tuna and menhaden fisheries (Douglas and Gorenbein, 1968; Hynd, 1968; Pearcy and Mueller, 1970; and Pearcy, 1971). In both fisheries, however, the application of these techniques is limited. In the tuna fishery, for example, SST fields are recorded and transmitted, but with little or no interpretation; in the menhaden fishery, aircraft overflights are used merely as an improved visual scouting method. The coho salmon forecast system, therefore, appears to provide a significant development in fish forecasting techniques. As far as can be determined, it is the first system to bring so many factors to bear on the problem of forecasting the location of those elements which would indicate harvestable fish stocks. Specifically, the factors were a detailed knowledge of the environment, including knowledge of the

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three-dimensional offshore shelf circulation pattern gained through the CUE-I experiments, and standard meteorological forecasting coupled with the principle of continuity. During the test period, 41 forecasts were issued, of which 38 did locate favorable conditions for an accuracy rate of 92.7 percent.

THE OPERATIONAL FORECAST SYSTEM

Organization and the data flowpath for the operational phase is diagrammed and shown in Figure 1. The personnel organization used during the pilot program is indicated.

A Cessna 182 Skylane[1] was used for the daily SST mapping flight. This high-winged, single-engine aircraft was equipped for remote SST measurement with a narrow-band (10-12 μm) Precision Filter Radiometer (Barnes Engineering Co.; Model PRT-6 on loan from NASA-Ames Research Laboratory, Moffett Field, Calif.). For offshore navigation, the aircraft was equipped with a very-high frequency omnidirectional radio range receiver (VOR) with distance measuring equipment (DME). A 23-channel citizen's band (CB) radio was installed to allow direct communication with offshore trollers. During offshore flights, the aircraft crew wore inflatable life vests and carried a complete rescue and survival kit.

The daily flight would characteristically begin at 1100 hours, after development of a flight plan and a ground calibration of the PRT-6. A typical flight path is shown in Figure 2, which the aircraft flew at an altitude of 500 feet and an average speed of about 120 mph. During the flight the PRT-6 output, in recorder chart form, was annotated with navigational reference points and other observations appropriate to the evaluation effort, such as location of waterfronts, color changes, birds, fish, and fishing boat concentrations. Navigational reference points in the primary area off Newport and Depoe Bay were determined using a range and bearing from the Newport VOR transmitter. All such reference points were within the 30-mile range of the Newport facility. In the northern area, reference points were determined using the Newport facility coupled with visual sightings of prominent landmarks.

Upon completion of the flight the PRT-6 was again calibrated to determine in-flight instrument response drift, if any. Using this data, a calibration chart was constructed. Then the temperature data were transferred directly to a plot of the aircraft track over the study area. The calibration was checked using sea surface "ground truth" temperatures provided daily by offshore charter boats and commercial fishing vessels.

From the above, a near "real-time" (immediate analysis) SST map was prepared (Fig. 3), which formed the basis for the forecast. In addition to the SST, the forecast required a historical knowledge of the wind field and SST patterns over the past several days, a general knowledge of the three-dimensional offshore circulation, and a forecast of the wind field expected to be present in the study area (Fig. 4). Taking these factors into account, and assuming the principle of continuity, the forecast was prepared.

The forecast consisted simply of a

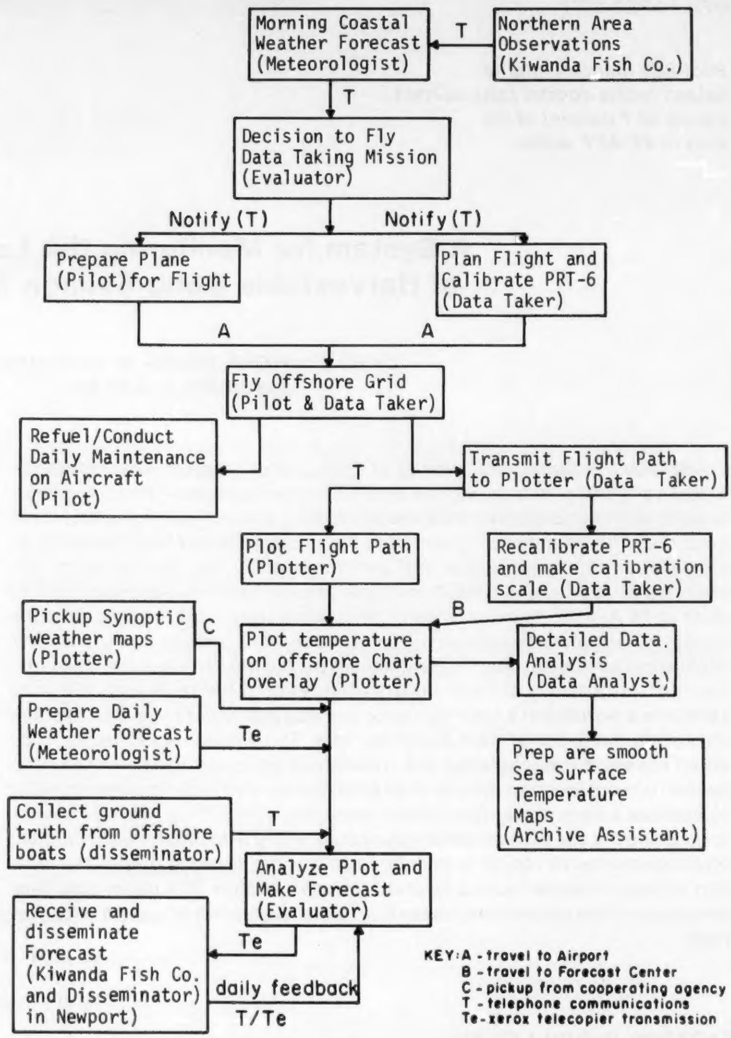


Figure 1.—Data flow for coho forecast.

[1]Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

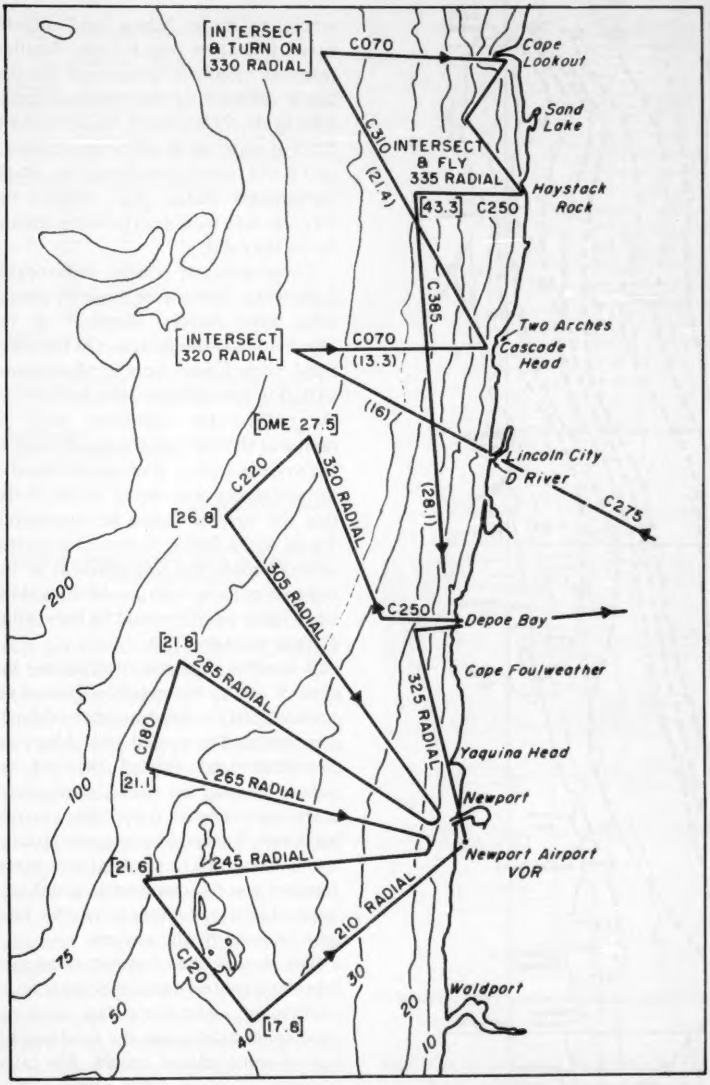


Figure 2.—Typical offshore grid for SST mapping flight.

copy of the SST field mapped on the day the forecast was issued and a word description of observations, projected conditions, and fishing recommendations. The SST map was superimposed over a chart showing rate 1L0 loran lines of position and bottom contours in fathoms. Use of a single 1L0 loran line and depth is the two point navigation system in common usage in the area. Figure 5 shows a typical forecast issued during the program.

Rapid dissemination of the forecast was effected by telecopying it to user location on the coast at Newport and Pacific City. From Newport the forecast was recorded for commercial radio broadcast, passed to a CB radio operator for transmission to offshore trollers, posted at public waterfront locations, and distributed to charter boat operators in both Newport and Depoe Bay. Figure 6 outlines the distribution system in its final form. Using this system the forecast would be disseminated typically by about 1900 hours.

FEEDBACK TO THE SYSTEM

Communication with the user was important for three purposes: 1) as the system was being developed, constructive operational criticism was desired; 2) daily feedback of offshore "groundtruth" temperatures was required to check the accuracy of the airborne measurements; and 3) data were required in order to evaluate the system.

During the project, the telephone was used frequently by fishing boat operators to make comments on the system but, by far, most operational criticism was received through the forecast disseminator or from the data sheets issued to cooperating fishing boat operators. Figure 7 shows the data sheet used in the study. It was designed to provide the data necessary for a statistical and subjective evaluation of the system with a minimum of inconvenience for cooperators. The sheets were submitted anonymously at about weekly intervals.

SYSTEM EVALUATION

The evaluation of the coho prediction system was conducted from two points of view. One was strictly subjective in nature and the second was statistical. The subjective evaluation was based on the comments and observations made by the people involved in, or affected by, the system. It should be noted that these comments plus the data used in the statistical evaluation came primarily from the smaller boats. Since it is expected that the small fishing boat operators, with the least experience, would be more likely to use the forecast, it is felt the statistics are biased in favor of the system. If the experienced fisher using the larger trip boats had submitted data sheets, much better catch rates from the areas recommended by the forecast could be expected. The most significant conclusion to be drawn from these comments is that the system, as designed, was being utilized by fishers even though it was experimental; furthermore, most of those involved expressed the hope that it would be continued in the future.

For more detailed evaluations, participants were asked for daily comments to be recorded on the data collection sheets (Fig. 7). The comment most frequently made was that the forecast was useful in that it gave an indication of

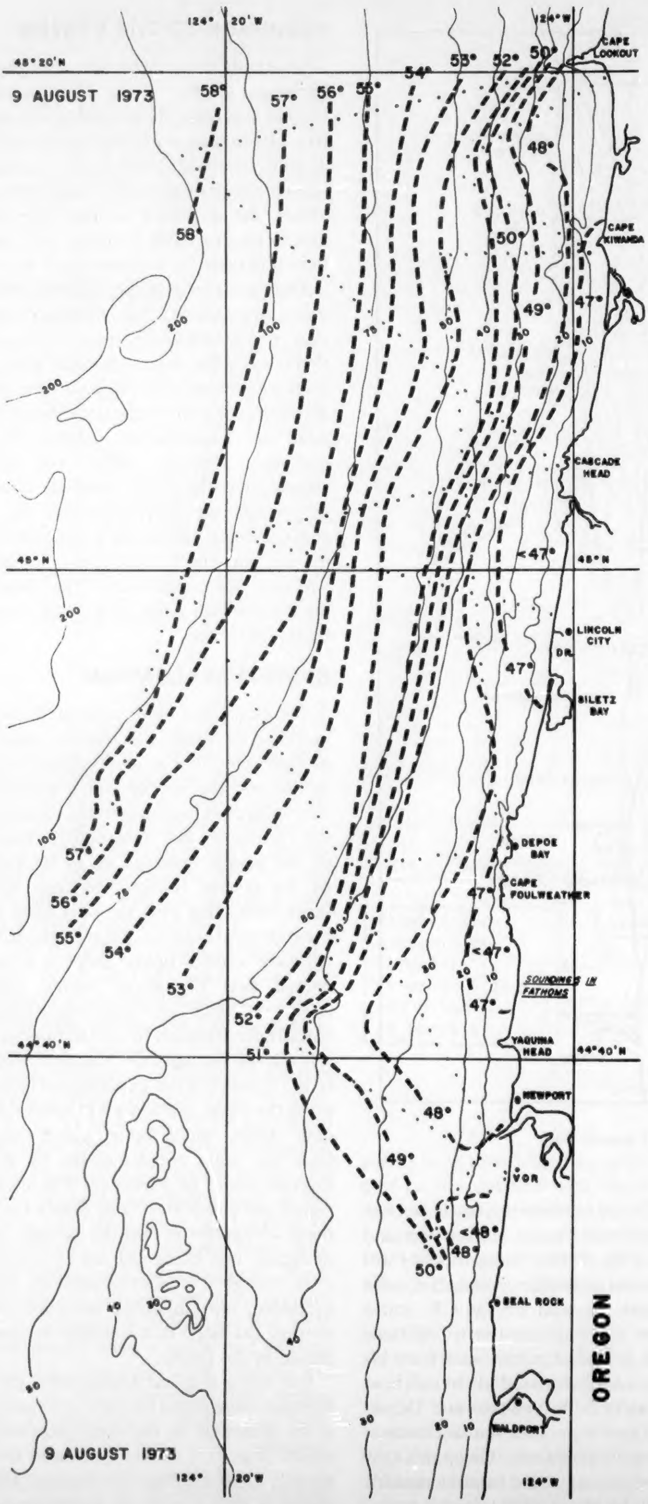


Figure 3.—SST map for 9 August 1973.

where to begin fishing and thereby saved transit or search time. Another frequent comment concerned the distance offshore of the forecast areas. During the 1973 season, the 52° to 56°F band of water quite often was located 2 to 3 hours transit time from port. Many participants stated that without the forecast they would not have traveled as far as they did.

There were, of course, unfavorable comments. Some were made by people who were merely skeptical of the capabilities of the system. On the other hand, some fishers were firmly opposed to it. It is interesting to note that none of the unfavorable comments were directed at the operational capabilities of the system. In fact, it seems that most of the resistance was based on the belief that the system would be successful. There was a feeling that such a system would benefit the less efficient at the expense of those with good fishing skills since more people would be harvesting a given school of fish.

A number of people were against the system due to the potential hazard associated with a large number of boats concentrated in a small area. Many experiences were related showing the danger in such situations, particularly when compounded by fog. The system, however, did not pinpoint any specific spots of water. The smallest area in any forecast was 60 square miles which was approximately 4 percent of the total area covered by the system.

The statistical evaluation of the system was based on data collected from 41 participants. The basic data were the time spent fishing and the total poundage of coho salmon caught. For comparative purposes, some of the participants were specifically asked not to use the forecast but still submit data sheets. The primary point of comparison was the individual catch rate on a pounds-per-hour basis. The hypothesis for evaluation was that the system would locate bodies of water having relatively higher concentrations of coho salmon than surrounding water and as a result those fishing in these areas would enjoy an above average harvest.

A catch rate was computed for every data sheet submitted by the participants which was deemed relevant and useable. Although a total of 309 reports

COASTAL WINDS FOR OFFSHORE COHO ENVIRONMENTAL FORECAST

VALID 1500PDT THU - 1500PDT FRI, 9-10 AUGUST 73

DISCUSSION:
A WEAK UPPER LEVEL TROUGH IS PUSHING INLAND THROUGH OREGON TODAY TRIGGERING WIDESPREAD SHOWERS ALONG THE COAST RANGE AND THUNDERSTORMS THROUGH THE CASCADES. AS THE TROUGH MOVES FURTHER EAST TONIGHT, A STRONG PUSH OF MARINE AIR WILL FILL THE VALLEY WITH MARINE AIR. NORTHERLY WINDS WILL CONTINUE FRIDAY BUT THE ADDITIONAL MOISTURE IN THE VALLEY WILL HOLD THERMAL GRADIENTS DOWN SO NO STRONG COASTAL WINDS ARE EXPECTED THROUGH SATURDAY MORNING.

NEWPORT WINDS DURING THE PAST 24 HRS:

DATE	TIME(PDT)	DIRECTION	SPEED(KTS)
8	1600	NNW	12
	1800	N.W-NNW	4
	2000	NNW	2
	2200	NNW-NW	3
9	0000	NW	1
	0200	SW	3
	0400	SW	1
	0600	SW-N	3
	800	YSW	3
	1000	SW-NNW	5
	1200	NNW	5
	1400	NW	6

FORECAST TONIGHT:
LIGHT VARIABLE WINDS MOSTLY WEST TO NORTHWEST.

FORECAST FRIDAY:
LIGHT WEST TO NORTHWEST WINDS IN THE MORNING BECOMING MOSTLY NORTHWESTERLY 10-20 KTS IN THE AFTERNOON. MORNING LOW CLOUDS AND FOG. MOSTLY SUNNY IN THE AFTERNOON EXCEPT FOR PERSISTENT FOG OFFSHORE.

OUTLOOK SATURDAY:
MODERATE NORTH TO NORTHWEST WINDS....SUNNY IN THE AFTERNOON.... CHANCE OF PERSISTENT FOG OFFSHORE.

A. JOHNSON, JR.
CUEA STAFF METEOROLOGIST
9 AUGUST 1973

Figure 4.—Meteorological report used for coho forecast on 9 August.

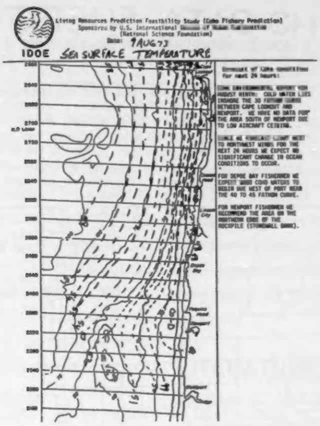


Figure 5.—Coho forecast prepared on 9 August for 10 August fishing period.

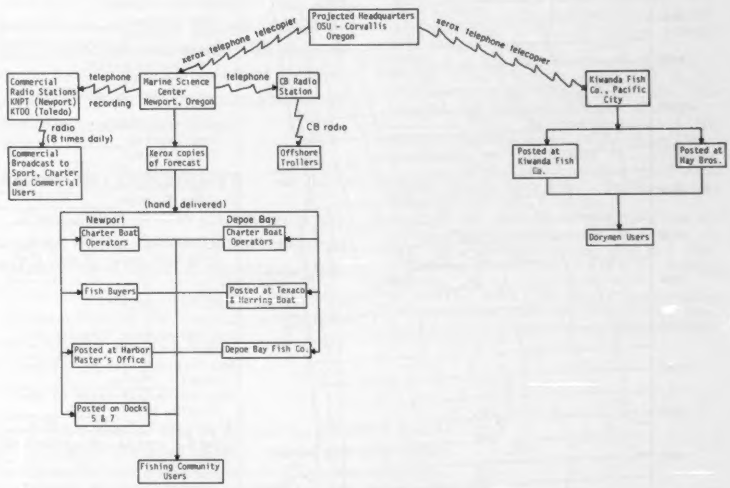


Figure 6.—Coho forecast distribution system—summer 1973—Newport, Depoe Bay, and Pacific City, Oreg.

were submitted, only 150 were used in the analysis. The reduction is due to two factors: discarding the 15 to 30 June period in order to eliminate discrepancies caused by a lack of familiarity on the part of the participants with the data collection sheets; and discarding data sheets submitted by trip boat and charter boat operators as being irrelevant. Using these catch rates several frequency distributions were constructed, two of which will be discussed here. The first of these distributions is presented in Figure 8, showing the catch rates from 1 July to 16 August, which incorporates all of the data used in the analysis. As mentioned previously, the participants either used the forecast or did not, and in either case they were free to go to any area and fish.

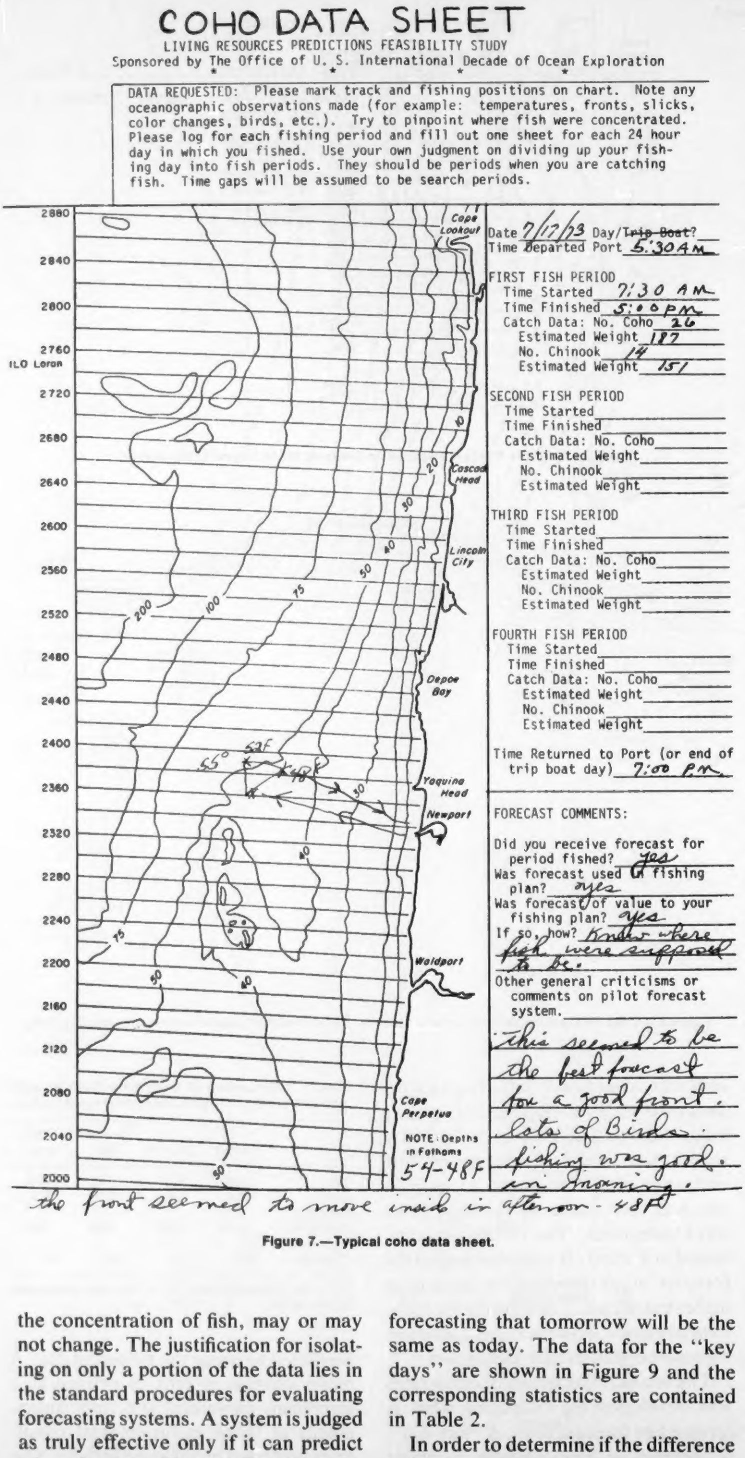
The data in Figure 8 have been coded according to three categories. The first category contains catch rates for days when no forecast was issued or no track was shown on the data sheet. Given that a forecast was issued and a track shown, the second category contains catch rates for boats in the forecast area and the third contains catch rates for boats fishing elsewhere. The determination of whether a catch rate should go into category two or three was based on a 1-day lag of the data sheets from the forecast date. In other words, if a forecast was issued on 7 July, tracks from data sheets of 8 July were used to place a boat. This procedure was followed to reflect the actual dissemination and utilization of the forecasts. A comparison was then made on the data in all three categories. The results are contained in Table 1. It can be seen that the forecast areas produced a somewhat higher catch rate. Considering the standard deviation, however, this cannot be considered statistically significant.

Table 1.—Comparison of catch rates (lb/h) by users and non-users of the coho salmon forecast system.

	Overall	NF-NT[1]	Forecast area	Other areas
Mean	13.05	11.41	15.88	12.41
Median	10.0	9.0	10.0	9.0
Standard deviation	9.54	9.70	9.88	9.94
Number of reports	150	64	46	40

[1]NF = No forecast issued; NT = No track was shown on data sheet.

The second distribution of catch rates was developed by examining what is termed key forecast days. A "key day" is defined as one wherein a major change in oceanographic conditions is predicted to occur the following day. A major change, in turn, is defined as a significant movement (i.e., not anticipated) of those environmental conditions preferred by the coho salmon. The size of the forecast area, and therefore



COHO DATA SHEET

LIVING RESOURCES PREDICTIONS FEASIBILITY STUDY
Sponsored by The Office of U. S. International Decade of Ocean Exploration

DATA REQUESTED: Please mark track and fishing positions on chart. Note any oceanographic observations made (for example: temperatures, fronts, slicks, color changes, birds, etc.). Try to pinpoint where fish were concentrated. Please log for each fishing period and fill out one sheet for each 24 hour day in which you fished. Use your own judgment on dividing up your fishing day into fish periods. They should be periods when you are catching fish. Time gaps will be assumed to be search periods.

Date 7/17/73 Day/~~Trip Boat~~?
Time Departed Port 5:30 AM

FIRST FISH PERIOD
Time Started 7:30 AM
Time Finished 5:00 PM
Catch Data: No. Coho 26
Estimated Weight 187
No. Chinook 14
Estimated Weight 151

SECOND FISH PERIOD
Time Started
Time Finished
Catch Data: No. Coho
Estimated Weight
No. Chinook
Estimated Weight

THIRD FISH PERIOD
Time Started
Time Finished
Catch Data: No. Coho
Estimated Weight
No. Chinook
Estimated Weight

FOURTH FISH PERIOD
Time Started
Time Finished
Catch Data: No. Coho
Estimated Weight
No. Chinook
Estimated Weight

Time Returned to Port (or end of trip boat day) 7:00 P.M.

FORECAST COMMENTS:

Did you receive forecast for period fished? yes
Was forecast used in fishing plan? yes
Was forecast of value to your fishing plan? yes
If so, how? Knew where fish were supposed to be.
Other general criticisms or comments on pilot forecast system.
this seemed to be the best forecast for a good front. lots of Birds. fishing was good. in morning.

the front seemed to move inside in afternoon - 48F

Figure 7.—Typical coho data sheet.

the concentration of fish, may or may not change. The justification for isolating on only a portion of the data lies in the standard procedures for evaluating forecasting systems. A system is judged as truly effective only if it can predict when changes will occur. For example, a weather forecaster gets no credit for forecasting that tomorrow will be the same as today. The data for the "key days" are shown in Figure 9 and the corresponding statistics are contained in Table 2.

In order to determine if the difference between mean catch rates in the forecast areas and the non-forecast area was statistically significant, a statistical test, Student's t-test, was applied to the data from Figure 9. The test is intended to show the likelihood that two samples were drawn from a common population. The null hypothesis for this test was H_O: Both samples were drawn from a common body of water. Using t-test computations, the conclusion is to reject the null hypothesis with more than a 98 percent degree of confidence that the hypothesis is in error. The interpretation of this test on our data is that it is very unlikely (less than a 2 percent probability) that the two samples came from a common population. In other words, the mean catch rate in the forecast areas on "key days" was significantly higher than the mean catch rate in non-forecast areas on those same days.

It should be noted at this point that there was considerable variability among the participants in the study in such things as the size of vessel and amount of equipment aboard, fishing gear, and, undoubtedly, in fishing skill. Any of these factors could affect the catch rates used in evaluating the forecast system. Unfortunately, it is not possible to determine the impact which they may have had due to the guarantee of anonymity promised the participants.

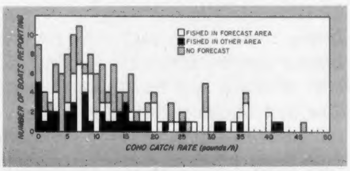


Figure 8.—Overall catch rates (lb/h) for period 1 July-15 August 1973.

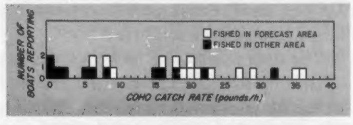


Figure 9.—Catch rates (lb/h) on "key days".

Table 2.—Comparison of catch rates (lb/h) on "key days" by users and non-users of coho salmon forecast system.

	Overall	Forecast area	Other areas
Mean	15.88	20.51	10.49
Median	16.0	20.0	6.0
Standard deviation	10.88	8.73	9.71
Number of reports	26	14	12

It is presumed, however, in light of the freedom to choose a fishing location, that the data represent a reasonably random sample, thus effectively neutralizing these factors.

RESULTS

The limiting factors, operationally, were the aircraft and weather. A small aircraft can effectively map an offshore area 60-80 miles long, out to 20 or so miles offshore, within its range of endurance. Within its range, the Cessna 182 Skylane proved to be an ideal economical aircraft for the system. During the 62-day life of the project no flights were missed due to aircraft, personnel, or equipment failure. The weather, however, was another matter.

In the Oregon area, where coastal upwelling is a major oceanographic phenomenon during the summer, the colder inshore waters, in contact with warmer moisture-laden marine air, induce a high incidence of low level fog. Except for an occasional summer storm, this fog was the primary reason for missed flights. During the test period, despite intensive effort, SST mapping flights were possible only 58.1 percent of the time. This fact leads to the conclusion that the aircraft should fly from a location as near as possible to the area to be mapped in order to take advantage of temporary periods of extended visibility.

The system was in operation for only one season; hence, it must be recognized as only one datum point in terms of long run potential. Nevertheless, within its own time frame, the system did prove to be operationally feasible. The pilot program was successful in locating 52°-56°F water 92.7 percent of the time. Statistical analysis of the catch rate data has shown the forecast system to be capable of locating harvestable stocks of coho salmon. In particular, on "key days," the catch rate in recommended areas was double that in other areas. For a more detailed statistical and economic evaluation see (O'Brien et al., 1974a, b, and c). Finally, this analysis lends credence to the hypothesis that coho salmon are a temperature dependent species. In view of these results, the system could provide a valuable input in the management of fisheries resources.

ACKNOWLEDGMENTS

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MFR PAPER 1178

An Analysis of Increasing Costs to Gulf of Mexico Shrimp Vessel Owners: 1971-75

WADE L. GRIFFIN and JOHN P. NICHOLS

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INTRODUCTION

The shrimp industry in the Gulf of Mexico is undergoing a difficult transition period at present. Lower shrimp prices coupled with rapidly escalating prices for fuel and other input items have brought about a cost-price squeeze that has literally put the vessel owners in a struggle for economic survival. The energy crisis had the most devastating impact on an industry beset by low production in 1973 and 1974. Fishing is a highly fuel-intensive industry and with high and rising fuel costs the immediate future promises continued economic hardship for the shrimp industry.

This report is intended to provide current information on the economics of owning and operating a shrimp vessel in the Gulf of Mexico. Cost and returns estimates in this report are based on 1971 and 1973 data collected from shrimp vessel owners. More specifically this report includes: 1) Estimated break-even annual shrimp catches with various ex-vessel shrimp prices for 1971, 1973, 1974, and 1975; and 2) Evaluation of expected cost and returns in 1975.

DATA AND METHOD OF ANALYSIS

Data Description

Cost and return and financial data used in this study were gathered by personal interviews with shrimp vessel owners and/or managers operating from ports in Florida, Mississippi, and Texas. Additional financial information was obtained from officials of various lending institutions which engage in shrimp vessel financing. Cost and return estimates for 1971 used in this report are based on a sample of 29 vessels from 53 to 72 feet in keel length and constructed of wood, steel, or fiberglass[1]. Cost and return estimates for 1973 used in this report were based on a sample of 115 vessels. Vessels from the 1973 sample were constructed of wood or steel, with a keel length from 54 to 78 feet[2]. Costs for 1974 were calculated by increasing all 1973 cost items (fixed and variable) by 20 percent[3], except fuel which was increased from 18 to 32 cents per gallon. Inflation is expected to continue at a rate between 10 and 20 percent; therefore, 1975 costs were increased by 15 percent over 1974 levels.

Method of Analysis

Cost and return data provide a basis for investigating the price-quantity relationships that will allow the vessel owner to just break even. For a given price per pound of shrimp landed, break-even analysis determines the quantity of shrimp that must be landed so that the revenue from sale of shrimp is just equal to the costs incurred for landing the shrimp. Costs may include both variable and fixed cost, depending on the type of break-even analysis considered.

Four different types of break-even analysis are presented in this report. They are: 1) break-even net returns; 2) break-even cash flow with loan payment; 3) break-even cash flow without loan payment; and 4) break-even cash flow just meeting variable cost. Break-even net return analysis is concerned with the profitability of the vessel, whereas the other three analyses are concerned with meeting cash outflow for operating the vessel. All four of the break-even analyses include variable cost, which takes into account the expense items as a result of going fishing, such as ice, fuel, repair and maintenance, crew shares, etc. Fixed cost included in the break-even analysis: net revenue analysis includes insurance, overhead, depreciation[4], interest[5], payment on borrowed capital and owners return to equity capital; cash flow with loan payment includes insurance, overhead, and principal and interest payment on borrowed capital; and cash flow without a loan payment is insurance and overhead. For these break-even calculations, it is assumed that variable operating costs were constant because most of the costs (except crew shares, payroll taxes, and packing charges) would be incurred before the vessel sailed, once a decision to leave port had been made.

BREAK-EVEN ANALYSIS

Break-Even Net Returns

Break-even net returns[6] for alternative ex-vessel prices and pounds landed for operating a vessel in the Gulf of Mexico in 1971 and 1973 and estimated

[1] For a complete description of this data see Lacewell et al. (1974). The data in the original publication was broken down into two groups; however, for this report they were combined into one group.

[2] For a complete description of the data see Wardlaw and Griffin (1974).

[3] Based on wholesale price index for 1974 (Board of Governors of the Federal Reserve System, 1974).

[4] Depreciation charges were calculated using the straight line method, based on the estimated new replacement value for each vessel, and using an 8-year depreciation life with 35 percent book salvage value.

[5] For the amortization schedule the equivalent new vessel costs were used with 67 percent of that value financed for 8 years at 9 percent interest, and 12 equally amortized payments per year.

[6] Break-even net returns include a 9 percent return to owner's equity capital.

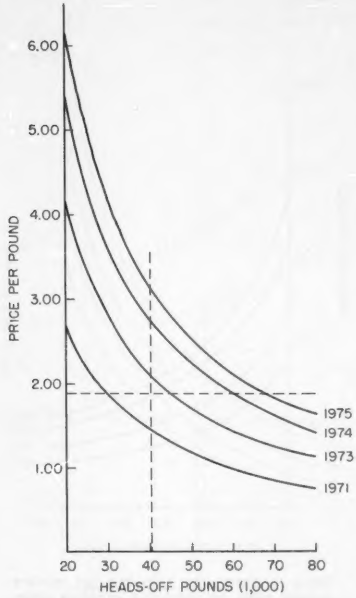

Figure 1.—Break-even net returns for alternative ex-vessel prices and pounds landed for operating a vessel in the Gulf of Mexico in 1971 and 1973 and estimated for 1974 and 1975.

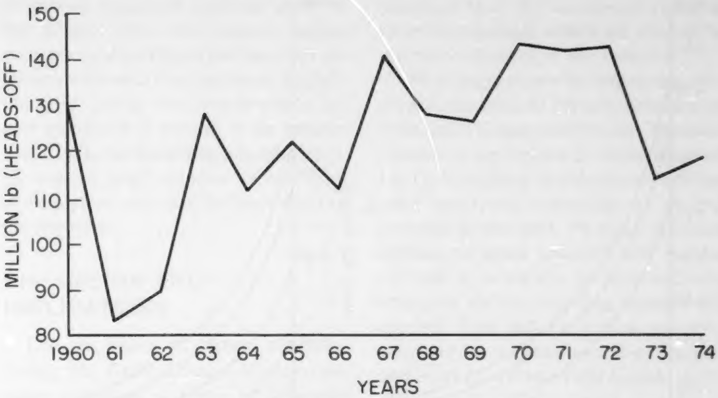

Figure 2.—Total shrimp landings in the Gulf of Mexico for years 1960-74. Landings for 1974 are estimated.

for 1974 and 1975 are presented in Figure 1. For comparison purposes, the vertical dashed line indicates the 1973 average landings for all vessels and the horizontal dashed line indicates the average ex-vessel price per pound received by the 115 vessels in the 1973 data sample.

As Figure 1 illustrates, holding the average price constant at $1.88 per pound, break-even quantity landed would have to be approximately 27,000 pounds in 1971, 45,000 in 1973, 60,000 in 1974, and an expected 68,000 in 1975. At an ex-vessel price of $1.88 per pound, the required pounds landed to have break-even net revenue increased 18,000 pounds from 1971 to 1973. However, it should be pointed out that the average pounds landed in 1971 was slightly over 52,000 pounds, and the average price received was $1.20. Hence, actual vessel production had declined 12,000 pounds from 1971 to 1973.

At an ex-vessel price of $1.88, the 1973 average vessel production level was 5,000 pounds less than that needed to break even. Thus, the average vessel owner had negative net returns from vessel operations in 1973.

At an ex-vessel price of $1.88, the required pounds landed would have to increase approximately 15,000 pounds (20,000 pounds above actual 1973 production) from 1973 to 1974 to have break-even net revenue. However, in Figure 2, which shows the total shrimp landings in the Gulf of Mexico for the years 1960-74, landings in 1974 were only about 4 percent above 1973 landings. This implies that landings per vessel probably did not increase substantially in 1974 over 1973. Hence, at an ex-vessel price of $1.88 per pound, substantial negative net returns occurred in 1974.

Now holding landings per vessel constant, price changes are determined to maintain a break-even position. At 40,000 pounds per vessel, the required ex-vessel price that vessel owners would have to receive to have break-even net revenue would be approximately $1.30 in 1971, $2.05 in 1973, $2.75 in 1974, and $3.15 in 1975. The actual price received in 1971 was $1.20; thus, at 40,000 pounds a loss of $0.10 per pound would have been incurred. In 1973 the actual price was $1.88 per pound of shrimp landed; thus, a loss of $0.17 per pound would have been incurred.

The ex-vessel price per pound of shrimp landed for total Gulf landings for the years 1960-1974, shown in Figure 3, indicates that the actual price received declined in 1974. Hence, in 1974 the ex-vessel price received by vessels similar to those in the sample was probably also less than the $1.88 per pound received in 1973, implying a loss in excess of $0.87 per pound ($2.75 − $1.88 = $0.87). Expectations for 1975 will be discussed later.

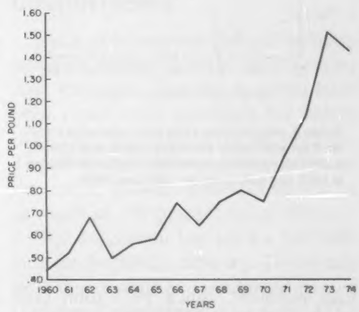

Figure 3.—Ex-vessel price for Gulf of Mexico shrimp landed (heads-off) for years 1960-74. Prices for 1974 are for January-October.

Break-Even Cash Flow with Loan Payment

Break-even cash flow requires that the cash inflow from revenue be just equal to all cash outflow for operating a shrimp vessel. Break-even cash flow, with a loan payment for alternative ex-vessel prices and pounds landed for operating a vessel in the Gulf of Mexico in 1973 and an estimation for 1974 and 1975, are shown in Figure 4[7]. The dashed lines again refer to actual 1973 pounds landed and ex-vessel price received.

At a price of $1.88 per pound vessel owners would have had to produce 41,000 pounds in 1973, 51,000 pounds in 1974, and an expected 57,000 pounds in 1975. In 1973, vessel owners produced on the average approximately 1,000 pounds short of the actual production needed for break-even cash flow with

[7]Adequate data were not available to calculate loan payment from 1971 figures.

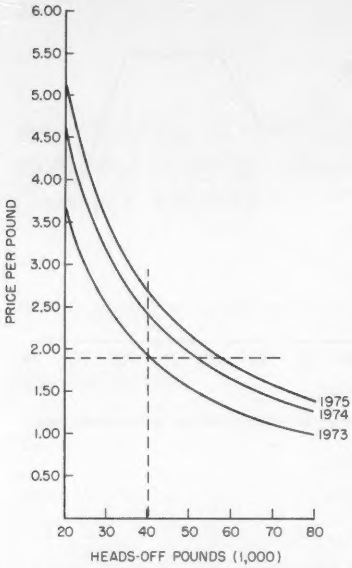

Figure 4.—Break-even cash flows with a loan payment for alternative ex-vessel prices and pounds landed for operating a vessel in the Gulf of Mexico in 1973 and estimated for 1974 and 1975.

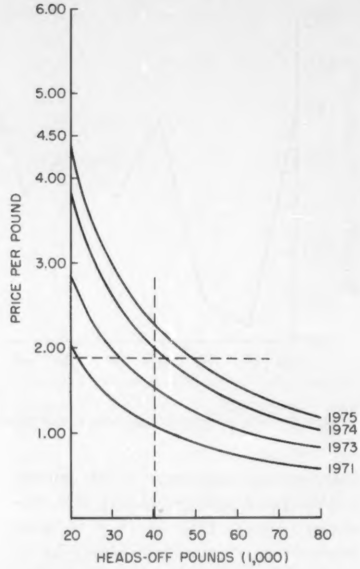

Figure 5.—Break-even cash flow without a loan payment for alternative ex-vessel prices and pounds landed for operating a vessel in the Gulf of Mexico in 1971 and 1973 and estimated for 1974 and 1975.

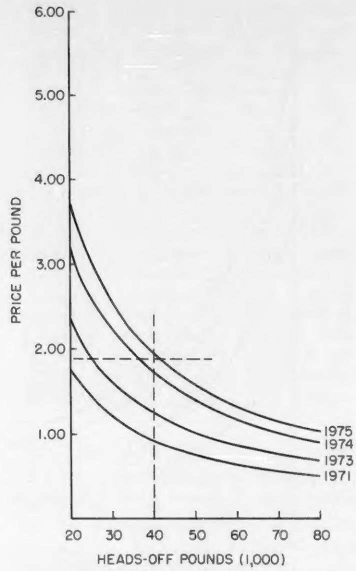

Figure 6.—Break-even cash flow just meeting variable costs for alternative ex-vessel prices and pounds landed for operating a vessel in the Gulf of Mexico in 1971 and 1973 and estimated for 1974 and 1975.

loan payment. Since 1974 total Gulf landings were only 4 percent above 1973 landings, it can be assumed that average landings per vessel did not increase significantly. Thus, production was approximately 11,000 pounds less than needed for break-even cash flow with loan payment.

Assuming production per vessel remains constant at 40,000 pounds landed, ex-vessel price received would have to be \$1.95 in 1973, \$2.40 in 1974, and \$2.70 per pound of shrimp landed in 1975. Based on prices received of \$1.88 per pound in 1973, vessel owners under conditions described above had a net cash outflow of \$0.07 per pound of shrimp landed. Since ex-vessel prices were probably below the 1973 prices, vessel owners had a net cash outflow in 1974 in excess of \$0.52 per pound of shrimp landed.

Break-Even Cash Flow Without a Loan Payment

Break-even cash flow without a loan payment for alternative ex-vessel prices and pounds landed is illustrated in Figure 5. At a price of \$1.88 per pound, vessel owners would have had to produce 20,000 pounds in 1971, 31,000 pounds in 1973, 42,000 in 1974, and an expected 49,000 pounds in 1975. Thus, at a price of \$1.88 per pound, vessel owners could have more than adequately met all their cash expenses other than loan payments in 1971 and 1973; however, in 1974 some cash expense items would be left unpaid or they would be living off cash reserves. Assuming landings per vessel were constant at the 1973 level of 40,000 pounds and 1974 prices were lower than 1973, vessel owners had a net cash outflow in excess of \$0.10 per pound of shrimp landed.

Break-Even Cash Flow Just Meeting Variable Costs

Break-even cash flow just meeting variable cost for alternative ex-vessel prices and pounds landed are shown in Figure 6. At a price of \$1.88 per pound and an assumed production of 40,000 pounds landed, vessel owners will have difficulty meeting trip expenses in 1975.

The significance of this is evidenced by observations that many vessel owners were tying up their vessels and not sending them out during the first part of 1975. Losses in the first part of 1975 were also compounded by the normal seasonality of revenue received from producing shrimp. Figure 7 shows the percent of annual revenue received each month by vessel owners during 1971. Although profits were made in 1971, the first 5 months showed negative cash flows (Hayenga, Lacewell, and Griffin, 1974).

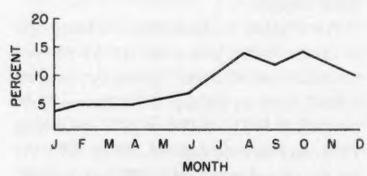

Figure 7.—Percent annual revenue received each month based on all Gulf vessels between 66-72 feet in keel length that landed shrimp in 1971.

Expectations for 1975 Conditions

To facilitate the discussion of the current situation, the estimated 1975 break-even curves presented earlier for each set of conditions are shown in Figure 8. Based on 1973 level of production and price received, vessel owners will

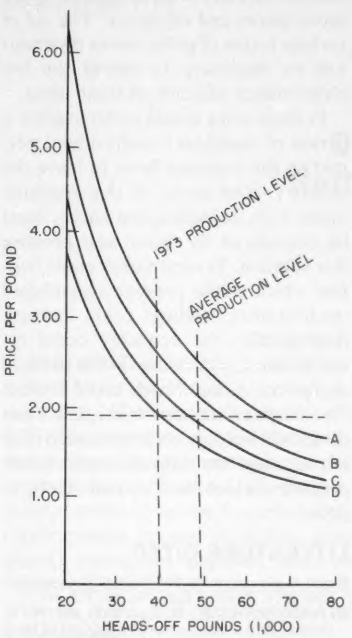

Figure 8.—Estimated break-even: a) net returns; b) cash flow with loan payment; c) cash flow without loan payment; d) cash flow just meeting variable costs for a vessel operating in the Gulf of Mexico in 1975.

not even be able to cover variable cost (trip cost) much less any of the fixed cost items such as insurance, overhead, etc. As stated in the previous section, if conditions do not improve, vessels will be tied up and the number of vessels in the industry will decline unless sufficient cash reserves or additional financing is available.

Also included in Figure 8 is a second vertical dashed line at 49,000 pounds labeled average production level. As indicated earlier, 1973 production of shrimp from the Gulf was below normal. Thus, based on a production function estimated by Nichols and Griffin (1974) for the Gulf of Mexico shrimp fleet where catch is a function of effort, average annual landings for the vessels in the sample were estimated in a normal year to be approximately 49,000 pounds. Reading from the figure, estimated break-even prices for normal production are: $2.60 for net returns, $2.20 for cash flow with loan payment; $1.80 for cash flow without loan payment, and $1.60 for cash flow just meeting variable costs. If 1975 was a normal year for production and ex-vessel price of shrimp remained constant at $1.88 per pound, then the average vessel owner would just have met his cash expenses without a loan payment. In 1975 the Gulf shrimp fleet continued to experience liquidity strains. If the present situation holds for a long enough period of time, a large number of the Gulf shrimp producers will be forced out of the industry.

DISCUSSION AND IMPLICATIONS

The resolution of current problems facing the Gulf shrimp industry may come about as a result of changing economic conditions and/or changes in specific policies which may or may not be initiated or suggested by the industry. A number of possible changes have been suggested which bear consideration. Among these are changes which have the basic impact to stabilize or increase returns for the shrimp landed and others which have the effect of reducing costs.

Price and Revenue Considerations

Import quotas and tariffs are one suggested alternative to the current cost-price squeeze in the industry. By controlling imports it is anticipated that supplies on the market can be reduced, thus preventing prices from being depressed below the domestic producer's costs. Two points should be noted here. The goals of free trade and stabilized or lower consumer prices may make it difficult to get the necessary controls approved through the political process. A good deal of caution will be necessary in regulating imports to prevent chaotic conditions which could be to the long run detriment of the industry, including the domestic fisher.

Market expansion and development programs have also been suggested as a means of shifting demand and increasing prices. With current conditions of declining real income and low prices for competing protein sources (red meat and chicken), it is difficult to expect a rapid shift in demand for a product such as shrimp, which has traditionally enjoyed a position as a luxury item in the market place. Market development is a long-term process and the industry should commit itself to such a program. This suggests a greater continuity of programs than the occasional reaction to crisis situations which are evident in the recent history of the industry.

Other suggestions for improving vessel revenue include the consideration of alternative fishing enterprises. These alternatives are limited in many areas of the Gulf because development has not been nearly as rewarding as shrimp trawling in the past. Perhaps seasonal shifting to other fisheries will be developed as a regular pattern and revenues to shrimp trawling vessels improved. This will be a slow process, however, as techniques are developed and market systems established.

Cost and Efficiency Considerations

Much of the current difficult industry situation can be traced to an increasing cost structure. This has resulted from both rapid price increases for inputs (fuel, nets, etc.) and declining landings. Together these factors have increased the cost of landing a pound of shrimp by as much as 100 percent since 1971.

One suggestion has been a fuel subsidy for the fishing industry. This would be a direct saving to vessel owners on the largest single input cost item. At an average 49,000 pounds of shrimp landed per vessel it would take a subsidy of from 25 to 30 cents per gallon for the average producer to break even with a loan payment when he receives an average of $1.88 per pound for his shrimp. Chances of obtaining relief in this area are very slim. At best, the extent of such relief would likely be limited to future increases related to oil import taxes. Current fuel expenses would probably not be reduced.

Efforts to improve the efficiency of fishing operations are also a priority consideration. The operation of fishing vessels during periods of marginal profitability requires improved management and closer consideration of the effects of the day-to-day decisions in running the vessel.

Another means which has been suggested to reduce cash outflow is to finance vessels over a longer period of time to reduce the size of monthly mortgage payments. A reduction of the loan payment by one-half would have the effect of reducing break-even cash flow with loan payment by 20 cents per pound at an average landing of 49,000

pounds per vessel. This will not reduce unit costs but would permit continued ownership of the vessel through periods when cash receipts are low. This would require considerable refinancing of existing vessels through either private or government-backed agencies. In addition strong consideration should be given to making monthly payment seasonally proportional to revenue.

A much larger question should be introduced in this discussion of efficiency. The industry appears to be suffering from over-capitalization in fishing vessels. One classic solution to this is a total fisheries management scheme which includes a limited entry concept. Other conditions assumed equal, this would increase catch per unit of effort and would result in lower costs per unit of shrimp landed. This is not a short-run solution, however. It is only now being experimented within United States fisheries. A great deal of planning and information would be needed to design and implement such a program.

Long-run problems of limited entry include the possibility of creating a stagnant, protected industry which loses touch with both the consumer market and the market for resources (inputs for harvesting shrimp). In the long-run this may be more detrimental than going through periodic readjustments such as that which the industry currently faces. If it can be assumed that the relative position of the unit cost and revenue remains constant in the future and also assumes a normal production year, then based on this sample of 115 vessels, the percentage reduction in vessels needed for break-even can be calculated. In a normal year, these 115 vessels would have landed a total of 5.6 million pounds of shrimp. For each vessel to have break-even net revenue each vessel would have to land 66,000 pounds of shrimp. Dividing 66,000 pounds per vessel into 5.6 million pounds implies that the sample total production of 5.6 million pounds could only support approximately 85 vessels or 74 percent of the vessels sampled[8]. Likewise, for break-even cash flow with loan payment each vessel would have to land 57,000 pounds of shrimp, which implies that the sample total production of 5.6 million pounds could support approximately 98 vessels or 85 percent of the vessels sampled.

CONCLUSIONS

The shrimp industry is currently undergoing considerable stress. The underlying causes relate to factors in the general economy beyond industry control and the rapid expansion in potential fishing effort which occurred during the period since the late 1960's. Means of coping with this stress include both improved management to reduce costs and various industry-wide programs to improve prices and efficiency. The aid of various forms of government programs will be necessary to permit the implementation of some of these ideas.

Perhaps some would prefer to allow a period of significant readjustment permitting the marginal firms to leave the industry. The costs of this readjustment, both economic and social, must be considered by those who propose this solution. Several things could happen which would prevent a significant readjustment; landings could increase dramatically, the economy could recover quickly thus improving demand and prices, or input costs could decline. The chances are, however, that these things will not happen soon enough (if at all) to avoid the difficult readjustment problems which now appear likely to occur.

[8]It is obvious that if the total Gulf shrimp fleet was reduced to 73 percent of its current size, total production would also decrease. That is, the estimated reduction in the fleet should be adjusted with respect to the production function. Calculations using the production function made less than a 1 percent difference.

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MFR PAPER 1179

Offshore Headboat Fishing in North Carolina and South Carolina

GENE R. HUNTSMAN

ABSTRACT—Headboats operating on the outer Continental Shelf of North Carolina and South Carolina made a recreational catch of 489,570 fish weighing 1,313,247 pounds with 49,989 angler days of effort in 1972 and a catch of 513,174 fish weighing 1,595,228 pounds with 59,815 angler days in 1973. Mean catch-per-angler day was approximately 26 pounds. Species caught represent a community of tropical, deepwater fish typical of Caribbean Banks. Fishes most commonly taken included red porgy, Pagrus sedecim, *black sea bass,* Centropristis striata, *vermilion snapper,* Rhomboplites aurorubens, *white grunt,* Haemulon plumieri, *and mixed groupers,* Epinephelus *sp. and* Mycteroperca *sp. Red, silk, and blackfin snappers,* Lutjanus campechanus, L. vivanus, *and* L. buccanella, *were highly prized by the fishers but were caught infrequently.*

A productive and interesting recreational fishery for bottomfishes is conducted from headboats along the coasts of North Carolina and South Carolina[1]. Despite the northerly latitude of this fishery, it produces large catches of fishes usually associated with Caribbean and Bahama reefs and banks: groupers (*Epinephelus* and *Mycteroperca*), snappers (*Lutjanus* and *Rhomboplites*), porgies (*Calamus* and *Pagrus*), and grunts (*Haemulon*). Even though this fishery was obviously popular and the catches large, no knowledge of it existed, other than in the minds of fishers and headboat operators, until our study began in January 1972.

In this paper I wish to: 1) briefly describe the geography and oceanography pertinent to the fishery; 2) review the history of scientific research and fishery development in the study area; 3) describe the vessels, gear, and techniques used in the fishery; 4) document the catches and expenditure of effort in the fishery for the 1972 and 1973 fishing seasons; and 5) review factors affecting the future of the headboat fishery.

[1]Headboats are those where anglers pay for a day's fishing on a per person (thus per "head") basis.

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GEOGRAPHY AND PHYSICAL ENVIRONMENT OF THE FISHERY

Headboats, operating out of ports from Hatteras, N.C., to Charleston, S.C., fish the outer Continental Shelf from Cape Hatteras, N.C., to Savannah, Ga. (Table 1) (Fig. 1). The fishing area is divided into three large bays and an unnamed region south of Cape Romain. Raleigh Bay lies between Cape Hatteras and Cape Lookout, Onslow Bay between Cape Lookout and Cape Fear, and Long Bay between Cape Fear and Cape Romain (Fig. 1). The presence of tropical fishes this far north depends on two features of the physical

Table 1.—Headboats of North and South Carolina, 1972 and 1973.

Location	Headboat	Fishing area	Operated in 1972	Operated in 1973
North Carolina				
Hatteras	*Shady Lady*	Offshore	—	X
Morehead City	*Capt. Stacy*	Offshore	X	X
"	*Capt. Stacy III*	Offshore	X	X
"	*Deep Blue*	Offshore	X	X
"	*Carolina Princess*	Inshore	X	X
Sneads Ferry	*Pirate*	Inshore	X	X
Topsail Island	*Buddy Pirate*	Inshore	X	X
Topsail Beach	*Buccaneer*	Inshore	X	X
Carolina Beach	*Stew Bird II*	Inshore	X	X
"	*Carl Winner Queen*	Inshore	X	—
"	*Cheerio II*	Inshore	X	X
"	*Flying Squirrel*	Inshore	X	—
"	*Pirate-Too*	Inshore	X	—
"	*Capt. Winner IV*	Offshore	—	X
Wrightsville Beach	*Capt. Skippy Winner*	Offshore	X	X
Southport	*Skipper*	Inshore	X	X
South Carolina				
Little River	*Capt. Juel I*	Offshore	X	X
"	*Hurricane*	Inshore	X	X
"	*Gulf Queen*	Offshore	X	—
"	*Bonita*	Inshore	—	X
Murrells Inlet	*Flying Fisher I*	Inshore	X	X
"	*Flying Fisher II*	Inshore	X	X
"	*Capt. Alex*	Offshore	X	X
"	*Rocket*	Inshore	X	—
"	*Tom-A-Gator*	Inshore	X	—
"	*Carolina Princess*	Offshore	X	X
"	*Capt. Bill*	Offshore	—	X
Charleston	*Gulf Stream II*	Offshore	X	X
"	*Mustang II*	Inshore	X	X
"	*Comanche*	Inshore	X	X
"	*J. J.*	Inshore	X	X

environment: the rugged bottom topography and the warming influence of the nearby Gulf Stream.

The outer Continental Shelf, that zone from 15 fathoms seaward to the Continental Slope, furnishes two types of habitat attractive to reef fishes. The most spectacular of these two habitats is the shelf break zone (Struhsaker, 1969) where the ocean floor slopes abruptly from the Continental Shelf to the Continental Slope. The shelf break, which usually lies between 30 and 100 fathoms, is a rugged area of jagged peaks, precipitous cliffs, and rocky ledges. The other type of habitat, less spectacular but equally productive, includes numerous rocky outcroppings and coral patches of low profile (Huntsman and Macintyre, 1971) that are scattered over the flat bottom shoreward of the shelf break area.

Water temperature on the outer shelf is strongly influenced by the Gulf Stream and is sufficiently high to allow year-round occupancy by tropical and subtropical fishes. For instance, bottom water temperature along the 50 fathom curve is near 57°F the year-round, and as far north as the center of Raleigh Bay bottom temperatures may remain near 68°F during winter (Stefansson and Atkinson, 1967).

Figure 1.—Area fished by Carolina headboats. Photo courtesy of H. Gordy.

HISTORY OF FISHERY RESEARCH AND FISHERY DEVELOPMENT ON THE OUTER CAROLINA SHELF

Fishery Research

Neither scientists nor fishers displayed much interest in the fishes of the outer shelf until the last two decades. The RV *Fish Hawk* cruises in 1902 and 1913 were searches for sea bass fishing grounds on Onslow Bay coral patches and did not investigate deeper water (Smith, 1905; Radcliffe, 1914). An RV *Albatross III* cruise in May and June 1949, featuring roller trawling from 10 to 150 fathoms in Raleigh, Onslow, and Long bays (Buller, 1951), captured a few red grouper (*Epinephelus morio*) and red porgy (*Pagrus sedecim*) but failed to provide substantive information on shelf break fish stocks. Cruises by the MV *Combat*, MV *Silver Bay*, and RV *Oregon* (Bullis and Thompson, 1965) included trawling at or near the shelf break of Raleigh, Onslow, and Long bays. Work of the RV *Silver Bay* was significant because it allowed Struhsaker (1969) to describe fish habitats off the southeast coast and furnished the best collections of fishes ever made in that area. The cruises of the MV *Silver Bay* have provided the best available description of the stocks of demersal fishes on the shelf break even though sampling was diffuse. Bad weather, rough bottom, and a greater interest in shallower waters precluded more than a few trawl or hand-line stations and some observations of fish concentrations with sonic instruments.

Recently the marine fishery agencies of North Carolina and South Carolina have conducted explorations of the outer shelf. Bearden and McKenzie (1971), using handlines and traps in 1970 and 1971, located concentrations of porgies, groupers, and snappers off South Carolina. Most sampling occurred south of Cape Romain. In 1969, the RV *Dan Moore* of North Carolina occupied 93 roller trawl stations in Raleigh and Onslow bays at depths from 10 to 60 fathoms (North Carolina, RV *Dan Moore* Cruise 020). A few catches of snowy grouper (*Epinephelus niveatus*) were made southeast of Cape Fear but trawling was often precluded by rough bottom at the shelf break.

In summary, every fishery study of the outer Continental Shelf of North Carolina and South Carolina has been primarily oriented to the discovery of commercial concentrations of demersal fishes, and has usually avoided bottom not fishable with commercial trawling gear. There has not been an intensive, multigear, research program oriented primarily toward describing the fish communities of the outer Shelf.

Fishery Development

While scientists were slow to study fishes of the outer shelf, it was not until the late 1950's that fishers began to recognize the importance of the potential fishery. In 1956 and 1957 two handline fishers, Lloyd Reed and John Chivas, made the 40-50 mile run to the shelf break from Morehead City, N.C. Fishing from a 38-foot boat, they accounted for most of the 300,000 pounds of groupers and snappers landed in North Carolina in 1957 (Power, 1959). In the winter of 1957-58 water temperatures in outer Raleigh, Onslow, and Long bays were the lowest recorded during the entire 20-yr period from 1948 to 1968 (McLain, Mayo, and Owen[2]). A large

[2]McLain, D. R., F. V. Mayo, and M. J. Owen. Monthly maps of sea surface temperature anomalies in the northwest Atlantic Ocean and Gulf of Mexico, 1948-67. Unpublished manuscript. Pacific Environmental Group, National Marine Fisheries Service, NOAA, c/o Fleet Numerical Weather Central, Naval Post Graduate School, Monterey, CA 93940.

mortality of red snapper, the only species with high market value, occurred and the commercial fishery ended.

In the mid-1960's a sport fishery conducted primarily by headboats began to develop. About 25 headboats now operate over the outer shelf from Cape Hatteras to Charleston (Table 1). Charter and private boats engage in recreational bottom fishing over the outer shelf at times, but their fishing effort appears comparatively small.

Traditional wooden hulled headboat at Morehead City, N.C. Photo courtesy of H. Gordy.

Fishery Equipment and Methods

Headboats fall into two major classes according to the habitat they fish: 1) those that fish the inshore rocks and coral patches from 15 to 25 fathoms (inshore boats), and 2) those that fish the shelf break zone and the extreme outer shelf from 25 to 80 fathoms (offshore boats).

All vessels must have a large passenger capacity and be able to attain high speed. Capacity varies between 30 and 75 anglers. Offshore vessels are often constructed along the lines of the fast, powerful crew boats used in the oil industry and usually are powered by two V-12 diesel engines. Some vessels may attain speeds of 25 knots, although 15 knots is probably average. Inshore boats average from 10 to 15 knots. Since the success of a trip depends on the ability of the captain to find fish, most boats are equipped with sensitive depth recorders to detect fish schools and loran to enable the relocation of productive areas. Vessels are usually crewed by a captain and two or three mates.

An aluminum hulled catamaran headboat at Carolina Beach, N.C. This type of vessel affords more comfort and angling space than conventional headboats, but the initial cost is great.

Tackle is sturdy enough to resist the abuse of heavy fish, constant use, and inexperienced anglers. Solid 5- to 6-foot fiberglass rods, with the rod blank extending through the butt, are preferred. Reels are size 6/0 to 9/0, either manual or electric, and line is 80- to 120-pound test monofilament. The bottom rigs are usually made of 80-pound test monofilament and two 6/0 to 8/0 hooks connected with three-way brass swivels that help prevent twisting of the rig and aid in freeing tangles. During fishing aboard our own research vessel, we found that a two-hook bottom rig of 250-pound test monofilament fastened with crimped sleeves will hold almost any fish other than sharks (Fig. 2). It will not kink, and yet will allow sharks to cut themselves loose and save us the trouble of fighting and landing them. Crimped sleeves fasten securely and are faster and easier to use than knots. Another bottom rig, which is especially effective for scamp, has a single hook and slip sinker on the line above the swivel joining the line and leader (Fig. 3). Depending on the current and the depth fished, 6- to 28-ounce lead sinkers are used. Sinkers weighing up to 50 ounces may be used effectively with an electric reel. Heavy sinkers improve the presentation of bait during rough seas or when swift currents sweep lighter sinkers from the bottom.

A typical fishing day begins at daybreak and lasts from 12 to 16 hours. After a 2 to 4 hour trip to the fishing ground and a brief search either for fish or bottom topography likely to produce fish, anglers spend 4 to 6 hours fishing, and then return to port.

Fishing occurs at depths of 10-80 fathoms. Captains, in general, dislike fishing at depths greater than 35 fathoms because tangling is frequent and strong currents often prevent lines from reaching the bottom. Depending on conditions, captains may either drift or anchor. In water deeper than 30 fathoms anchoring is not practical. According to some headboat captains, anchoring produces the best catches of groupers and drifting allows the best catches of porgies and grunts.

A successful headboat angler debarks with an "average" catch which includes gray tilefish and vermilion snapper. Photo courtesy of H. Gordy.

CATCHES, EFFORT, AND ANGLING QUALITY

Survey Methods

Because there was no existing system of record keeping on headboats, we were forced to initiate our own system of collecting catch and effort data. To be successful, our system had to reflect four constraints: 1) the catch was intact and available for examination for only a few hours between the end of fishing and dispersion of anglers upon docking; 2) landings were made at irregular intervals at many widely scattered points; 3) the fishes, in general, were not sold so no records of transfer were available; and 4) we could not hire enough employees to meet all vessels. These constraints dictated that catch records be recorded by a crew member during the return to port. In addition, the crew member reported the number of anglers aboard and the location fished.

Because the daily catch records were

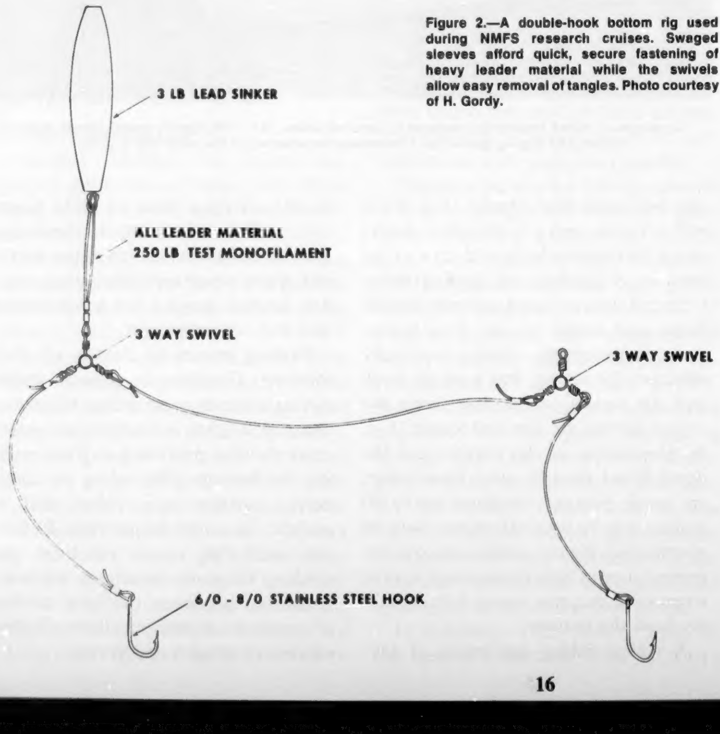


Figure 2.—A double-hook bottom rig used during NMFS research cruises. Swaged sleeves afford quick, secure fastening of heavy leader material while the swivels allow easy removal of tangles. Photo courtesy of H. Gordy.

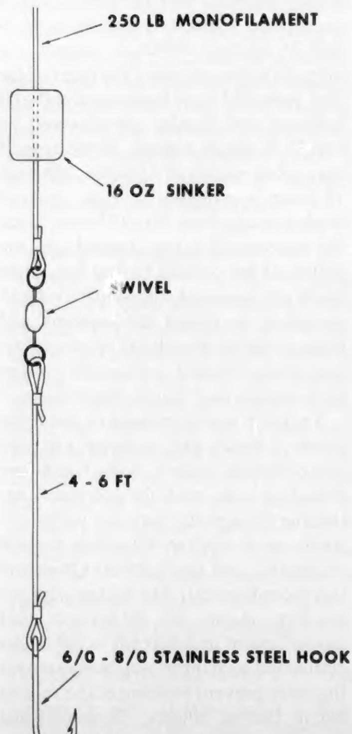


Figure 3.—This bottom rig, which features a sliding sinker and only a single hook, is very effective for taking scamp. Photo courtesy of H. Gordy.

essential to our research, we paid the crews a small fee. With this incentive we achieved 50 percent coverage by catch records of all headboat trips for June, July, and August 1972 and 1973. Catch record coverage was less in spring and fall when fishing was more sporadic and when many mates worked only part time. National Marine Fisheries Service (NMFS) personnel worked at dockside measuring and weighing fish, collecting stomachs and gonads for studies of food habits and reproductive cycles, and collecting scales and otoliths for age determination.

Total numbers of fish caught were obtained from the daily catch sheets kept by vessel personnel. When catch records were missing for some days within a month, we adjusted catches upward by multiplying the observed catch per angler day of each species by the total angler days for the month. This adjustment was performed separately for each boat. Total angler days were taken from vessel booking records. Multiplying the average weight, obtained through dockside sampling, of each species by the total numbers caught of that species furnished an estimate of catch weights. Calculation of confidence intervals is theoretically possible for each of our catch estimates, but the procedures used to compensate for missing data made such calculations difficult.

To facilitate the estimation and presentation of catch values we divided the fishing area from Cape Hatteras through South Carolina into four districts: Cape Hatteras, Cape Lookout, Cape Fear, and Cape Romain. Cape Hatteras vessels fish in the northern part of Raleigh Bay; Cape Lookout vessels in the southern part of Raleigh Bay and the northern half of Onslow Bay; Cape Fear vessels in southern Onslow Bay and the northern third of Long Bay; Cape Romain vessels in southern Long Bay and south to Savannah. Within each of the four districts we designated inshore and offshore subdistricts. We divided the fishing season into five time-units: March-May, June, July, August, and September-November. There is little fishing from December through February. The catches are presented by year, district, subdistrict, and time unit.

Working at dockside, NMFS employees sample catches of headboat anglers. Photo courtesy of H. Gordy.

Catches

Our sampling yielded both qualitative and quantitative information about the catches. Not only did sampling provide a list of species caught (Tables 2, 3), but also estimates of catch of each principal species or species group in both numbers and pounds (Tables 4, 5).

Table 2.—Species commonly taken by the Carolina headboat fishery.

Common name	Scientific name	Usual size taken (lb)	Depth (fathoms)	Remarks
Sea basses	Serranidae			
Rock hind	*Epinephelus adscensionis*	2-5	15-30	
Speckled hind	*E. drummondhayi*	4-12	25-55	
Yellowedge grouper	*E. flavolimbatus*	8-16	35-80	
Red hind	*E. guttatus*	2-5	15-30	
Red grouper	*E. morio*	10-20	20-35	
Warsaw grouper	*E. nigritus*	23-40	30-60	
Snowy grouper	*E. niveatus*	6-12	30-60	
Gag	*Mycteroperca microlepis*	3-6 inshore 12-40 offshore	15-55	
Scamp	*M. phenax*	15-20	20-55	Mid-Onslow Bay southward
Black seabass	*Centropristis striata*	0.5-2.0	7-30	
Porgies	Sparidae			
Red porgy	*Pagrus sedecim*	1.75-2.5 inshore 2.5-5.0 offshore	10-55	
Knobbed porgy	*Calamus nodosus*	3-5	10-30	Most common off South Carolina
Whitebone porgy	*C. leucosteus*	1-3	10-25	
Spottail pinfish	*Diplodus holbrooki*	1-2	10-20	
Longspine porgy	*Stenotomus caprinus*	0.5-1.5	20-55	
Snappers	Lutjanidae			
Red snapper	*Lutjanus campechanus*	18-22	20-55	
Silk snapper	*L. vivanus*	18-22	25-55	
Vermilion snapper	*Rhomboplites aurorubens*	u.5-1.5 inshore 1.6 offshore	15-55	
Grunts	Pomadasyidae			
White grunt	*Hameulon plumieri*	1-2	10-25	
Tomtate	*H. aurolineatum*	0.25-0.75	10-25	
Tilefishes	Branchiostegidae			
Gray tilefish	*Caulolatilus microps*	6-10	30-70	
Jacks	Carangidae			
Almaco jack	*Seriola rivoliana*	15-30	25-100	
Greater amberjack	*S. dumerili*	15-50	25-100	
Triggerfishes	Balistidae			
Gray triggerfish	*Balistes capriscus*	2-7	10-30	

Table 3.—Some fishes of the outer Continental Shelf of North Carolina taken by National Marine Fisheries Service sampling or occasionally by headboats.

Common name	Scientific name	Depth (fathoms)
	Carcharhinidae	
Silky shark	*Carcharinus falciformis*	15-70
	Sphyrnidae	
Scalloped hammerhead	*Sphyrna lewini*	45-50
	Rhinobatidae	
Atlantic guitarfish	*Rhinobatos lentiginosus*	39-78
	Ragidae	
Unidentified skate	*Raja* sp.	39-78
	Dasyatidae	
Unidentified stingray	*Dasyatis* sp.	39-78
	Muraenidae	
Blackedge moray	*Gymnothorax nigromarginatus*	15-60
Reticulate moray	*Muraena retifera*	47
	Congridae	
Conger eel	*Conger oceanicus*	40-55
Margintail conger	*Paraconger* cf. *P. caudilimbatus*	33
	Ophichthidae	
Palespotted eel	*Ophichthus ocellatus*	15-57
	Engraulidae	
Unidentified anchovy	*Anchoa* sp.	15-20
	Synodontidae	
Inshore lizardfish	*Synodus foetens*	13
Red lizardfish	*S. synodus*	37-58
Snakefish	*Trachinocephalus myops*	15-40
	Ogcocephalidae	
Pancake batfish	*Halieutichthys aculeatus*	39-78
Roughback batfish	*Ogcocephalus parvus*	39-78
Unidentified batfish	*Ogcocephalus* sp.	39-78
	Ophidiidae	
Striped cusk-eel	*Rissola marginata*	15-20
	Holocentridae	
Squirrelfish	*Holocentrus ascensionis*	28
Longspine squirrelfish	*Holocentrus* cf. *H. rufus*	28
	Fistulariidae	
Red cornetfish	*Fistularia villosa*	50
	Syngnathidae	
Lined seahorse	*Hippocampus erectus*	15-60
Unidentified pipefish	*Syngnathus* sp.	15-60
	Serranidae	
Bank sea bass	*Centropristis ocyurus*	15-60
Sand perch	*Diplectrum formosum*	15-50
Marbled grouper	*Dermatolepis inermis*	
Yellowfin grouper	*Mycteroperca venenosa*	
Roughtongue bass	*Ocyanthias martinicensis*	39-78
Creole-fish	*Paranthias furcifer*	
	Priacanthidae	
Bigeye	*Priacanthus arenatus*	
Short bigeye	*Pristigenys alta*	18-23
	Apogonidae	
Twospot cardinalfish	*Apogon pseudomaculatus*	18
	Branchiostegidae	
Atlantic golden-eyed tilefish	*Caulolatilus chrysops*	40-70
Sand tilefish	*Malacanthus plumieri*	28-50
	Rachycentridae	
Cobia	*Rachycentron canadum*	28
	Carangidae	
Round scad	*Decapterus punctatus*	15-18
	Lutjanidae	
Blackfin snapper	*Lutjanus buccanella*	30-50
Wenchman	*Pristipomoides aquilonaris*	
Yellowtail snapper	*Ocyurus chrysurus*	
	Sciaenidae	
Jacknife-fish	*Equetus lanceolatus*	18
Cubbyu	*E. umbrosus*	37-60
	Mullidae	
Spotted goatfish	*Pseudupeneus maculatus*	18
	Chaetodontidae	
Spotfin butterflyfish	*Chaetodon ocellatus*	18
Blue angelfish	*Holacanthus bermudensis*	18
	Pomacentridae	
Yellowtail reeffish	*Chromis* cf. *C. enchrysurus*	18
Dusky damselfish	*Pomacentrus* cf. *P. Fuscus*	40-50
	Labridae	
Yellowhead wrasse	*Halichoeres* cf. *Hgarnoti*	40-50
Pearly razorfish	*Hemipteronotus novacula*	30-50
	Sphyraenidae	
Great barracuda	*Sphyraena barracuda*	28
	Uranoscopidae	
Southern stargazer	*Astroscopus* cf. *A. y-graecum*	39-78
	Scorpaenidae	
Spinythroat scorpionfish	*Pontinus nematophthalmus*	39-78
Barbfish	*Scorpaena brasiliensis*	18-70
Deepreef scorpionfish	*Scorpaenodes tredecimspinosus*	18
	Triglidae	
Northern searobin	*Prionotus carolinus*	13-20
	Bothidae	
Eyed flounder	*Bothus ocellatus*	23
Summer flounder	*Paralichthys dentatus*	28
Dusky flounder	*Syacium papillosum*	15-23
	Balistidae	
Orange filefish	*Aluterus schoepfi*	18
Fringed filefish	*Monacanthus ciliatus*	23
Planehead filefish	*M. hispidus*	23
	Tetraodontidae	
Marbled puffer	*Sphoeroides dorsalis*	23
Bandtail puffer	*S. spengleri*	18

Qualitative Description of the Catch

Our lists of fishes (Tables 2, 3) not only provide information about the catch, but when considered with observations of fishing areas, allow an insight into the zoogeography of marine organisms. Most species caught were tropical deep-water fishes. Shallow-water tropical species such as the yellowtail snapper and Nassau grouper were extremely rare. Briggs (1974) summarized the numerous attempts to characterize the fauna of the South Atlantic region and to delimit the northern distribution of tropical fauna. Examination of this summary indicates that most, if not all, previous authors seem to have missed an essential point: that two faunas, one temperate and one tropical, exist side by side on the South Atlantic Shelf. The tropical fauna extends northward in a narrowing band along the Gulf Stream over the outer Continental Shelf to about Cape Hatteras. The shoreward portion of the shelf and the estuaries are inhabited by a typically temperate fauna (Smith, 1905). While previous discussions indicating overlapping faunal regions might lead one to believe that the Carolina Shelf shelters a complex mixture of temperate and tropical forms, actually the two faunal groups maintain their integrity to a great extent and exist side by side within separate thermal regimes.

Quantitative Description of the Catch

Total catches, exclusive of sea bass, were 489,570 fish weighing 1,313,247 pounds in 1972 and 513,174 fish weighing 1,595,228 pounds in 1973. We estimated the sea bass catch in 1973 to be

Table 4.—Season catches by Carolina headboats—1972[1].

Species		Cape Lookout, N.C.				Cape Fear, N.C.				Cape Romain				Total					
		Inshore	%	Offshore	%	Inshore	%	Offshore	%	Inshore	%	Offshore	%	Inshore	%	Offshore	%	Total	%
Porgies	No.	10,431	33	31,055	56	44,459	32	5,087	37	4,605	8	120,321	62	59,495	26	156,463	59	215,958	44
	Wt.[2]	21,052	29	94,878	33	80,688	35	11,399	23	10,135	14	300,706	50	111,875	30	406,983	43	518,858	40
Grunts	No.	11,752	37	664	1	54,739	40	3,273	24	23,566	41	42,144	22	90,057	40	46,081	18	136,138	28
	Wt.	19,646	27	1,498	1	88,159	39	7,252	15	36,148	51	75,510	13	143,953	39	84,260	9	228,213	17
Vermilion snapper	No.	5,828	19	11,126	20	22,966	17	1,245	9	29,108	50	10,571	5	57,902	26	22,942	9	80,844	17
	Wt.	9,371	13	33,735	12	21,916	10	1,795	4	23,219	33	17,054	3	54,506	15	52,584	6	107,090	8
Groupers *Epinephelus*	No.	859	3	2,323	4	537	—	1,154	8	9	—	2,908	1	1,405	—	6,385	2	7,790	2
	Wt.	11,236	15	28,395	10	4,573	2	11,564	23	34	—	36,168	6	15,843	4	76,127	8	91,970	7
Groupers *Mycteroperca*	No.	402	1	5,223	9	623	—	1,991	15	118	—	10,764	6	1,143	—	17,978	7	19,121	4
	Wt.	1,997	3	96,654	33	4,771	2	15,803	32	528	1	118,345	20	7,296	2	230,802	25	238,098	18
Red snapper	No.	155	—	816	1	218	—	33	—	16	—	949	—	389	—	1,798	1	2,187	—
	Wt.	2,553	4	14,801	5	4,352	2	291	—	118	—	18,754	3	7,023	2	33,846	4	40,869	3
Others	No.	1,955	6	4,330	8	13,696	10	804	6	317	1	6,430	3	15,968	7	11,564	4	27,532	6
	Wt.	6,963	10	20,941	7	24,412	11	1,815	5	760	1	33,259	6	32,135	9	56,015	6	88,150	7
Total no.		31,382		55,537		137,238		13,587		57,739		194,087	74	226,359		263,211		489,570	
Total wt.		72,818		290,902		228,871		49,919		70,942		599,796	64	372,631		940,617		1,313,248	

[1]No vessels operated in the Cape Hatteras District in 1972.
[2]All weights are in pounds.

Table 5.—Season catches by Carolina headboats—1973.

Species		Cape Hatteras, N.C.		Cape Lookout, N.C.				Cape Fear, N.C.				Cape Romain			
		Offshore	%	Inshore	%	Offshore	%	Inshore	%	Offshore	%	Offshore	%	Total	%
Porgies	No.	2,727	28.6	18,900	33.9	25,272	43.5	51,834	46.7	56,257	78.5	142,764	68.9	297,754	58.0
	Wt.[1]	9,060.1	21.1	34,020.0	31.8	78,121.4	22.8	94,204.2	26.2	173,690.2	65.5	356,576.8	55.1	745.672.7	46.4
Grunts	No.	562	5.9	19,064	34.2	1,208	2.1	40,681	36.7	8,389	11.7	9,520	4.6	79,424	15.5
	Wt.	1,240.0	2.9	32,408.8	30.3	3,176.1	0.1	64,149.2	31.4	19,220.3	7.2	22,658	3.5	142.852.4	8.9
Vermilion snapper	No.	2,498	26.2	14,718	26.4	18,241	31.4	15,641	14.1	512	0.7	32,030	15.5	83,640	16.3
	Wt.	7,450.8	17.4	19,672.8	18.4	60,056.7	17.5	24,091.2	11.8	1,721.7	0.6	43,844.7	6.8	156,837.9	9.7
Groupers *Mycteroperca*	No.	34	0.4	1,048	1.8	6,217	10.7	1,415	1.2	2,475	3.5	6,373	3.1	17,562	3.4
	Wt.	834.7	1.9	8,677.7	8.1	127,449.8	37.2	12,944.9	6.3	27,432.7	10.3	85,547.8	13.2	262,887.6	16.3
Groupers *Epinephelus*	No.	544	5.7	228	0.4	2,099	3.6	206	0.2	1,321	1.8	6,218	3.0	10,616	2.1
	Wt.	5,381.3	12.5	1,451.0	1.4	26,803.3	7.8	1,975.4	1.0	11,167.4	4.2	52,692.7	8.1	99,471.1	6.2
Red snapper	No.	100	1.1	9	0.01	1,886	3.2	101	0.1	271	0.4	1,615	0.8	3,982	0.8
	Wt.	1,452.8	3.6	135.2	0.1	27,023.4	7.9	830.3	0.4	3,018.6	1.1	27,762.5	4.3	60,222.8	3.7
Others	No.	3,054	32.1	1,801	3.2	3,146	5.4	1,038	0.9	2,431	3.4	8,726	4.2	20,196	3.9
	Wt.	17,413.3	40.6	10,682.2	10.0	20,217.0	5.9	5,896.4	2.9	15,592.6	10.9	57,483.2	8.9	127,284.7	8.7
Total no.		9,519		55,768		58,069		110,916		71,656		207,246		513,174	
Total wt.		42,833.0		107,047.7		342,847.7		204,091.6		251,843.5		646,565.9		1,595,229.4	

[1]All weights are in pounds.

211,000 pounds in North Carolina and believe an equal or greater amount was landed in South Carolina.

We did not estimate the sea bass catch in 1972 because when we began this study we were primarily interested in the tropical offshore species—grunts, snappers, groupers, and porgies—and, therefore, did not ask mates to keep records of sea bass catches. It was evident after one season, however, that the sea bass was an important member of the ecosystem at the shoreward limit of distribution of the more tropical fishes, and that the angling success on inshore boats could not be adequately represented without including sea bass. Red porgy, vermilion snapper, white grunt, and groupers were the most numerous fishes caught other than black sea bass.

Notes on Principal Fishes Caught

It is beyond the scope of this paper to completely describe each species or species group listed in Tables 4 and 5, but some salient comments on each of the principal fishes should be of value in understanding the fishery. The following species are discussed in descending order of importance as indicated by their total weight landed.

The red porgy, also called silver snapper, provided the largest catch in number and weight in both years and is clearly one of the most important recreational fishes of our southeast Atlantic Coast. In the Carolinas alone, approximately 216,000 porgies weighing 519,000 pounds were taken in 1972 and 298,000 weighing 746,000 pounds were taken in 1973. Red porgies are also taken off Georgia, the east coast of Florida, and in the eastern Gulf of Mexico.

The black sea bass, taken almost entirely by inshore boats, was probably the second most important species caught by weight.

Dockside sampling includes weighing and measuring fish and collecting scales that will reveal the age of fish sampled. Photo courtesy of H. Gordy.

Groupers are large bass-like fishes that include the scamp, gag, hinds, and others. The species composition varied over the range of the study. Scamp occurred only irregularly north of central Onslow Bay, but were extremely important to vessels fishing south of there. Gag were important throughout the fishery but were more abundant in the southern districts. Snowy and yellowedge groupers seemed abundant in deep water (60-80 fathoms) throughout our study area but appeared mostly in catches of northern boats, which more often fished deep areas. The speckled hind, a large fish that has been taken to 45 pounds in South Carolina and 38 pounds in North Carolina, was common throughout the area and, with the gag, appeared to have the most northern distribution. Warsaw groupers attained prodigious weights but were only caught occasionally. The records for Warsaw grouper are 245 pounds in North Carolina and 310 pounds in South Carolina. Several 100-pound Warsaw grouper are caught each year.

Vermilion snapper, often erroneously called red snapper aboard headboats, and grunts, principally white grunt, shared ranking as the fourth and fifth most productive species and were more numerous in the catch than groupers. Of the two, more pounds of grunts were caught in 1972; more pounds of vermilion snapper were taken in 1973. Vermilion snapper, caught from both offshore and inshore boats, were usually larger offshore. In 1972, those taken offshore averaged 2.9 pounds versus 1.1 pounds for those taken inshore.

Grunts were extremely important to inshore boats but also commonly occurred in the catches of offshore boats in South Carolina and southern North Carolina, where the fishing subdistricts seem less distinct than in the north. White grunt were often found with scamp grouper on rocks in 18 to 25 fathoms southward from mid-Onslow Bay, and with sea bass, porgies, and vermilion snapper northward.

Red snapper, yelloweye or silk snapper, and blackfin snapper, all commonly known as red snapper, were not abundant even though headboats advertise "red snapper fishing." Only 2,178 were taken in 1972 and 3,982 in 1973. They are, however, usually large, averaging over 18 pounds per fish in 1972 and 1973. Because of their large size, relative scarcity, and fine tasting flesh, fishers prize them highly.

Our category of "other fishes" includes greater amberjack, almaco jack, gray tilefish, and gray triggerfish. Available from 10 to over 100 fathoms, both jacks are large fierce fighters, the greater amberjack commonly attaining a weight of 50 pounds and the almaco, 25 pounds. Although the flesh is good tasting, few people eat it, possibly because 75 percent or more amberjacks carry heavy infestations of larval tapeworms in the flesh.

Gray tilefish, a relatively recent addition to headboat catches, are regularly taken from water deeper than 35 fathoms. Although of equally good flavor, they do not attain the size of the common tilefish, *Lopholatilus chamaelonticeps*, a popular sport fish of the northeast coast that appears to be a colder water species. In the southeast it might occur farther offshore than the gray tilefish.

Gray triggerfish, which anglers formerly viewed with disfavor but now accept with more enthusiasm, are common from 10 to 30 fathoms. Although good fighters, they are clever at stealing bait and are difficult to hook. Their flesh is white, sweet, very firm, and makes excellent chowder.

Effort

The amount and distribution of fishing effort changed from 1972 to 1973. Angling effort was 49,989 angler days in 1972 and 59,815 angler days in 1973 (Tables 6, 7)[3]. Major increases in effort occurred within the Cape Romain and Cape Hatteras offshore subdistricts. The operation of a headboat at Hatteras for the first time since the study began allowed accrual of effort there in 1973. Cape Romain offshore vessels carried more anglers in 1973 than in 1972 because of exceptionally good fall weather and also because anglers were apparently more abundant in 1973.

Distribution of effort changed not only because of vessels operating in new territory, as at Hatteras, but also because of changes in competition between vessels at a port. For instance, in the Cape Fear district, the addition of a new offshore vessel radically changed the distribution of effort between inshore and offshore vessels. The new

[3]An angler day represents the participation of one rod and reel angler in the headboat fishery for one full day (12 to 16 hours, including travel to and from the fishing ground).

vessel, a fast, aluminum catamaran, offered offshore fishing trips for the same price as the slower inshore vessels, attracting business away from the inshore boats, as well as from another offshore boat that charged more.

Table 6.—Catch and effort by Carolina headboats during the 1972 fishing season[1].

Time	Cape Lookout, N. C.		Cape Fear, N.C.		Cape Romain		All areas combined	
	Inshore	Offshore	Inshore	Offshore	Inshore	Offshore	Inshore	Offshore
Spring								
Angler days	754	1,192	1,536	110	352	736	2,642	2,038
Fish/day	3.3	6.7	14.9	6.4	14.5	14.0	11.6	9.3
Wt/day[2]	10.87	30.92	22.94	26.36	15.16	49.74	18.46	37.47
Wt/fish	3.2	4.6	1.5	4.1	1.0	3.5	1.6	4.0
June								
Angler days	767	1,757	3,162	379	1,137	3,186	5,066	5,322
Fish/day	4.6	5.3	10.6	7.8	12.8	15.7	10.2	11.7
Wt/day	9.98	31.49	17.3	32.73	12.96	46.92	15.11	40.82
Wt/fish	2.2	6.0	1.6	4.2	1.0	3.0	1.5	3.5
July								
Angler days	1,346	2,566	3,743	518	1,590	3,451	6,679	6,535
Fish/day	4.4	4.7	5.7	7.7	15.6	13.3	7.8	9.5
Wt/day	10.66	25.23	10.30	32.05	20.50	39.60	12.80	33.36
Wt/fish	2.4	5.4	1.8	4.2	1.3	3.0	1.6	3.5
August								
Angler days	1,449	2,582	2,640	402	2,007	3,080	6,096	6,064
Fish/day	8.1	6.4	9.0	7.8	6.6	12.9	8.0	9.8
Wt/day	18.38	32.37	14.59	24.94	9.09	43.38	13.68	37.47
Wt/fish	2.3	5.1	1.6	3.2	1.4	3.4	1.7	3.8
Autumn								
Angler days	964	1,857	2,462	473	—	2,791	3,426	5,121
Fish/day	8.0	5.3	14.5	5.9	—	17.2	12.7	11.8
Wt/day	16.56	27.11	25.32	16.86	—	51.37	22.86	39.38
Wt/fish	2.1	5.1	1.7	2.9		3.0	1.8	3.3
All seasons								
Angler days	5,280	9,954	13,543	1,882	5,086	13,244	23,909	25,080
Fish/day	5.9	5.6	10.1	7.2	11.4	14.7	9.5	10.5
Wt/day	13.79	29.22	16.89	26.52	13.94	45.28	15.58	37.50
Wt/fish	2.3	5.2	1.7	3.7	1.2	3.1	1.6	3.6

[1]No vessels operated in the Cape Hatteras District in 1972. [2]All weights are in pounds.

Table 7.—Catch[1] and effort by Carolina headboats during the 1973 fishing season.

Time	Cape Hatteras, N.C.	Cape Lookout, N.C.		Cape Fear, N.C.		Cape Romain		All areas combined	
	Offshore	Inshore	Offshore	Inshore	Offshore	Inshore	Offshore	Inshore	Offshore
Spring									
Angler days	—	1,494	2,741	2,041	452	—	3,422	3,535	6,615
Fish/day	—	8.1	5.0	15.5	9.6	—	9.9	12.3	7.9
Wt/day[2]	—	14.8	29.8	30.5	27.4	—	34.2	23.8	31.9
Wt/fish	—	1.8	5.9	2.0	2.9	—	3.5	1.9	4.1
June									
Angler days	—	1,516	2,341	2,251	501	—	3,638	3,767	6,480
Fish/day	—	8.0	4.5	11.81	9.6	—	11.3	10.3	8.7
Wt/day	—	14.4	23.9	21.2	35.6	—	33.1	18.5	29.9
Wt/fish	—	1.8	5.3	1.8	3.7	—	2.9	1.8	3.4
July									
Angler days	560	1,924	2,459	2,102	1,826	—	4,489	4,026	9,334
Fish/day	5.4	7.6	4.5	10.8	8.3	—	10.4	9.3	8.4
Wt/day	24.9	16.7	25.4	20.0	34.0	—	34.7	18.6	32.5
Wt/fish	4.7	2.2	5.6	1.9	4.1	—	3.3	2.0	3.9
August									
Angler days	695	1,140	2,107	948	1,815	—	3,666	2,088	8,283
Fish/day	5.4	5.3	4.8	14.2	9.6	—	9.3	9.3	7.9
Wt/day	22.3	8.8	27.7	23.1	33.1	—	30.4	15.3	29.6
Wt/fish	4.2	1.7	5.8	1.6	3.5	—	3.3	1.6	3.8
Autumn									
Angler days	343	1,721	3,694	1,108	2,899	—	5,622	2,829	12,558
Fish/day	8.2	6.4	3.4	15.0	9.6	—	9.1	9.8	7.5
Wt/day	40.0	11.9	22.9	27.2	31.1	—	25.3	17.9	26.3
Wt/fish	4.8	1.9	6.8	1.8	3.3	—	2.8	1.8	3.5
All seasons									
Angler days	1,598	7,795	13,342	8,450	7,493	—	20,837	16,245	43,270
Fish/day	6.0	7.2	4.4	13.1	9.6	—	10.0	10.3	8.0
Wt/day	26.9	13.7	25.7	24.2	35.4	—	31.0	19.2	29.7
Wt/fish	4.9	1.9	5.9	1.8	3.7	—	3.1	1.9	3.7

[1]Excluding sea bass.
[2]All weights are in pounds.

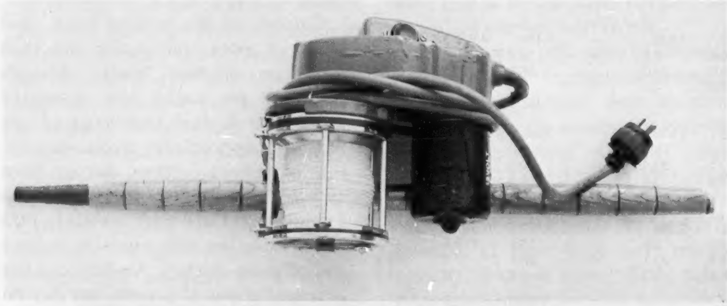
Angling Quality

Angling quality is a concept that relates to the satisfaction experienced by an angler as a result of the fishing trip. This satisfaction is derived from both objective components that relate to the catch, such as number and size of fish caught, and subjective components such as the fellowship experienced and the pleasure of being at sea. For this discussion we measured angling quality in terms of the number and weight of fish caught per angler and the average weight per fish caught (Tables 6, 7).

Headboat anglers aboard offshore boats took large catches and large fish. Weight of the catch per angler day in 1972 averaged 37 pounds for offshore boats; season averages for offshore and subdistricts ranged from 26.5 to 45.3 pounds. In 1973 the overall offshore average was 29.7 pounds and offshore subdistrict averages ranged from 25.7 to 31.0 pounds. Average catches tended to be higher in the Cape Fear and Cape Romain offshore subdistricts, possibly because the average angler day included slightly more fishing time in those subdistricts and possibly because good fishing was found at shallower depths than in the northern subdistricts. For all offshore subdistricts, average weights of fish ranged from a high of 5.9 pounds at Cape Lookout in 1973 to a low of 3.1 pounds at Cape Romain in 1972 and 1973.

Catches on the inshore boats consisted of more and smaller fish than those on offshore boats, although poundage per angler was about the same. Our limited knowledge of sea bass catches precludes precise description of inshore catches, but we have sufficient information from the Cape Lookout and Cape Fear vessels in 1973 to illustrate the differences in inshore and offshore catches. Anglers' catches averaged about 32 pounds per day on inshore vessels versus 28.4 pounds per day on offshore vessels, but the inshore catch was composed of much smaller fish than occur in offshore catches. Nearly half the inshore catch is of sea

The largest species available to Carolina headboat anglers is the Warsaw grouper. The fish pictured weighed 167 pounds, but some weighing over 300 pounds have been taken off the North and South Carolina coasts. Photo courtesy of H. Gordy.



Electrically powered 9/0 reel as used in the headboat fishery. Photo courtesy of H. Gordy.

bass and these rarely exceed a pound. In all inshore areas, species other than sea bass averaged 1.6 pounds in 1972 and 1.9 pounds in 1973; in all offshore areas they averaged 3.6 in 1972 and 3.7 pounds in 1973. The average size of inshore fish was smaller not only because there were fewer large species available, but because fish of the same species were usually smaller inshore than offshore (Tables 3, 4).

THE FUTURE OF OFFSHORE HEADBOAT FISHING IN THE CAROLINAS

Future prosperity in the Carolina headboat fishery will depend on the continued supply of fare-paying fishers, who will fish only if fishing success remains high. The availability of fish will be influenced by both natural and human phenomena. Natural phenomena that might seriously affect fishing would include, among many others, the intrusion of cold waters on the outer shelf such as occurred off Cape Lookout in the winter of 1957-58. Cold water, by fisher's accounts, killed mainly red snapper, which were seen floating at the surface. Since other species such as red porgy, vermilion snapper, groupers, grunts, and black sea bass were not seen, they were presumed to be unharmed. By 1964, when interest revived in fishing the outer shelf in Raleigh and Onslow bays, red snapper populations apparently had recovered. Catches initially were large, but fell off rapidly as fishing pressure continued. Red snapper now make up only a small part of the catch. A recurrence of cold water on the outer shelf, therefore, would probably not greatly affect the current headboat fishery, since it depends primarily on species that appear resistant to cold water.

Human influences on outer shelf fish populations include both indirect effects through environmental modifications and direct effects, especially fishing.

The southeastern Continental Shelf will soon be subject to exploration and development of offshore petroleum resources, and likely will become a site for nuclear-electric power plants. It is inevitable that the development of energy sources will affect fisheries of the South Atlantic Shelf. Some interactions will be deleterious while others may be beneficial.

Fishing affects some fish species much more than others. According to fishers, fishing can quickly reduce the populations of the large groupers and snappers. When fishing off Morehead

City resumed in earnest in the mid-1960's, large red and silk snappers were abundant, but after a few years they constituted only a small fraction of the catch. The best catches of snappers are usually made early in the year after little fishing pressure has occurred during the winter. Groupers as well as snappers seem easily depleted. Return rates of tags on speckled hind and scamp are 26 and 10 times, respectively, the return rate of tags on the abundant red porgy, indicating that these two groupers are much less abundant or much more vulnerable than porgies. In either case, fishing reduces the number of large predators much more quickly than it reduces the number of smaller ones.

Both tag returns and observations by fishers suggest that, because of the sedentary behavior of most species, intensive fishing may quickly reduce the productivity of a given fishing site even though the fish populations as a whole may be minimally affected. Where there are many competing headboats, such as on the east coast of Florida, angling success is reportedly much less than in former years. Where headboats are few and well scattered, as in the Cape Hatteras and Cape Lookout districts, captains tend to fish many sites to prevent overfishing any one, and fishing remains good.

The vulnerability of sites to intense fishing is the focus of a controversy between commercial handline fishers and headboat operators. Intensive fishing on one site probably has little effect on the population of fishes as a whole, but it could handicap headboat fishers by overexploiting accessible fishing spots. Commercial snapper boats will often fish on a productive site until the fish have ceased biting or are "all" caught. Often a year or more elapses before a site again provides acceptable fishing. To a commercial fisher who is highly mobile, the consequence of fishing out several sites is slight. Headboat operators are restricted to a single port and a rather stringent time schedule. They must expect to find good fishing within a few hours of the home port.

If they choose to preserve the present headboat fishery, resource managers would do well to avoid the traditional management goal of maximum sustained yield, and seek instead a goal of maximum catch per unit effort. Maximum sustained yield is usually achieved at some average catch per unit effort that is much less (perhaps 50 percent less) than in a virgin fishery. The success of the headboat fishery depends on a high catch per unit effort of large fish that can only come from lightly exploited populations. Only if anglers are guaranteed a high quality reward will they repeatedly pay $25 to $35 to undergo early morning departures, late returns, and 6-8 hours of pounding, monotonous riding for 4 to 6 hours of fishing. The catch per unit effort is now sufficiently high to earn much repeat business for the headboats. Management to attain maximum sustained yield would likely drop the catch per unit effort low enough to drive most of the sport fishers to other more rewarding, less demanding types of fishing. The collapse of the headboat fishery would be a major loss. In 1973 the Carolina headboat fishery landed 1.6 million pounds of edible fish, brought over a million dollars in fishing fees alone to Carolina coastal communities, and provided 60,000 angler days of recreation.

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MFR PAPER 1180

A Mobile Laboratory With Flow-Through Capability for Thermal Tolerance Studies of Aquatic Organisms

JOHN R. HUGHES, THEODORE H. BLAHM, and DONOVAN R. CRADDOCK

ABSTRACT—A mobile laboratory, designed for studies to determine the temperature tolerance of certain aquatic animals, is described. The laboratory is equipped with the apparatus and control systems necessary to supply water of controlled temperature for flow-through bioassay tests. The laboratory has been used to determine the upper lethal temperature levels for crab and flatfish at one site on Puget Sound in northwestern Washington State. It could be used at other sites in studies to determine the effect of either existing or proposed discharges of waste heat on resident species of fish and shellfish.

INTRODUCTION

The current energy crisis demonstrates the urgent need for additional sources of economical electric power for domestic and commercial use. Electrical generating plants operated by thermal nuclear energy eventually may be located on the shores of Puget Sound to help satisfy the growing demand for power.

Nuclear plants employing "once through cooling" can raise the temperature of the cooling water approximately 18°F above the ambient temperature of the intake water (Coutant, 1970). The average 1,000 megawatt nuclear plant uses about 2,000 cubic feet of cooling water per second (Sorge, 1969). This volume of heated water can have a tremendous impact on the marine environment and biota. Animals transported with the cooling water through the plant could be subjected to the total temperature increase, while animals in the heated discharge plume could be subjected to temperature increases as high as the maximum 18°F above ambient, depending upon their proximity to the discharge outfall.

If thermal nuclear power plants are located around Puget Sound their effects on the natural resources must be minimized. As a prerequisite, we should determine the effects of thermal increases on the animals inhabiting the aquatic environment where the plants may be located. Because the species of animals in different areas of Puget Sound vary considerably, thermal tests should be conducted at each site where a thermal nuclear plant is proposed.

This paper describes a mobile laboratory equipped with the necessary research apparatus to conduct thermal tolerance tests on selected aquatic organisms at field sites. The laboratory has already been used to test the upper thermal tolerance levels of Dungeness crab, *Cancer magister*, and two species of flatfish, English sole, *Parophrys vetulus*, and rock sole, *Lepidopsetta bilineata*, at one location on Puget Sound. It could be used at other locations for future studies.

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DESCRIPTION OF APPARATUS

Both the towing tractor and the mobile van used to house the test apparatus (Fig. 1) were acquired from Federal surplus supplies. The tractor is fitted with a conventional semitrailer hitch (fifth wheel); any similarly equipped tractor could be used to move the van.

The van is 24 feet long and 7.5 feet wide; the interior is 6.5 feet high. It contains 12 wooden test tanks constructed of ¾-inch thick plywood, painted with a nontoxic material and mounted in metal stands welded to each side of the van (Fig. 2). There are seven tanks on the left side and five on the right. Each test tank is 24 inches long, 18 inches wide, 18 inches deep, and holds approximately 20 gallons of water. A 12 × 18-inch viewing window is in the front of each

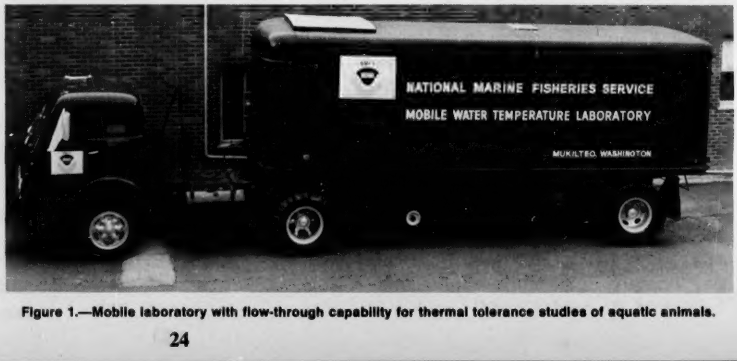

Figure 1.—Mobile laboratory with flow-through capability for thermal tolerance studies of aquatic animals.

tank. The tanks are supported approximately 1 foot above the floor by the metal stands. Constructed as an integral part of the stands above the tanks are counter tops that provide convenient work surfaces for measuring, weighing, and marking the test animals (Fig. 3). The counter tops also provide a convenient location for the equipment used to control and monitor water temperatures. Installed in the forward end of the right counter is a stainless steel sink that can be plumbed with freshwater for cleaning test equipment.

The pipes that supply water to the test tanks and the valves that control water flow to and temperature in the tanks are constructed of polyvinyl chloride; they are located on the underside of the counter tops. The main supply lines are 1.25 inches in diameter reduced to 0.5 inch at the control valves. The control valves and the flexible tubing from the valves to each test tank are 0.5-inch inside diameter. The level of water in the test tanks is controlled by 1.25-inch standpipes; 2-inch drain pipes run the length of the van on each side under the test tanks.

Two reservoirs, each 3 × 3 × 3 feet and constructed of 0.19-inch thick fiber glass, are located on metal stands at the front of the van approximately 3 feet above the floor. The reservoir on the left is equipped with three submersible electric water heaters, each rated at 10,000 watts. Each heater is comprised of two electrodes. The electrodes of one heater are electrically divided and operated manually so either one or both of the electrodes can be used at one time producing either 5,000 or 10,000 watts of energy for constant heating. The remaining two heaters are connected through relays to a thermostat that automatically controls the duty cycle (either individually or simultaneously, depending on the amount of water being heated) to maintain the water temperature in the heated reservoir at a preselected temperature. The electrodes of the heaters can be electrically selected to work in 5,000-watt increments to a maximum of 30,000 watts, depending on the volume of water heated. The heaters have the total capacity to heat approximately 6 gallons of water a minute from an ambient temperature of 50°F to 86°F. A rotary pump on the floor below the heated water reservoir circulates water through the reservoir to prevent thermal stratification.

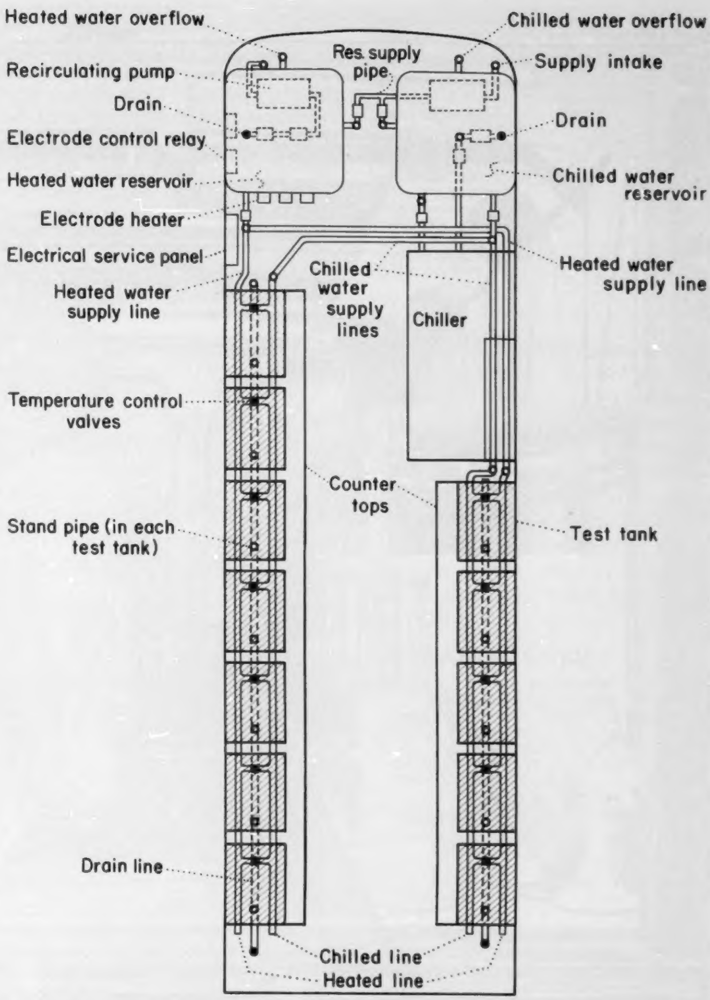

Figure 2.—Plan view of mobile laboratory. Pump supplies water to reservoirs where it is either heated (left) or chilled (right). Treated water flows by gravity through supply lines and temperature control valves to test tanks. Excess water flows out of test tanks through stand pipes to drains that carry it back to the source.

Behind the right reservoir (chilled water) and interconnected with it is a 3-ton chiller. This chiller has the rated capacity of cooling approximately 7.2 gallons of water per minute from 50°F to 40°F. A pump in the chiller circulates water from the reservoir through the chiller, preventing thermal stratification in the reservoir.

Water is supplied to the two reservoirs by a rotary pump located on the floor below the reservoir for the chilled water. The pump is capable of delivering approximately 50 gallons of water per minute with 20 feet of head. Intake water can be routed to either or both of the reservoirs by adjusting valves located between the pump and the reservoirs. A constant water level is maintained in the reservoirs by supplying more water than is being used in the test tanks. An overflow drain near the top of each reservoir carries the excess water out of the van, and back to the water source through drain hoses.

A 200-ampere, 240-volt, single phase, electrical service panel and a bank of electrical relays mounted near the

Figure 3.—Interior of mobile water temperature laboratory. Fishery biologist records observations as experiment progresses. Reservoirs for heated and chilled water are at forward end of van. Test tanks, supply lines, and temperature control valves are under counter tops. Drain lines are on floor under test tanks.

heated water reservoir comprise the electrical apparatus necessary to distribute electricity throughout the van for the heaters, chiller, pumps, temperature control equipment, lights, wall receptacles, etc.

PROCEDURE

Preparing the van for a series of thermal tests requires about 1 hour. A description of the procedures that are followed is presented below. First, the pump that supplies water is started and the two reservoirs are filled. The pump runs continuously; excess water is returned to the supply source through overflow drains. The heaters in the heated water reservoir and the chiller connected to the cold-water reservoir are started. When the water in each reservoir reaches the approximate desired temperature, the appropriate valves are opened and the water flows by gravity from the reservoirs through the supply lines to the test tanks. Individual valves are adjusted to supply the correct volume of heated and chilled water to maintain the desired temperature in each test tank. Assuming an ambient temperature of 50°F, the range of temperatures in the tanks can be controlled from about 40°F, using chilled water only, to as high as 86°F with heated water only.

The valves at each tank are adjusted to control not only the water temperature but also the volume of flow. An attempt is made to have approximately the same water volume flowing into each tank regardless of the temperature.

The temperature of the water flowing into each test tank is monitored by individual sensing probes placed in the tube that brings the water from the control valves to the tanks. The water temperature in the individual test tanks is periodically checked with a thermometer.

When the valves are properly adjusted at the test tanks and the water in the heated and in the chilled water reservoirs is stabilized at the desired maximum and minimum temperatures, the tests are started. Heated water used in some of the test tanks mixes in the drains with the chilled water used in other test tanks. The total volume of water can be discharged without further treatment and at approximately ambient temperature.

In our tests, the test animals were brought from holding tanks located outside the van and placed immediately in the test tanks. The number of animals tested in any one tank varied depending on the size of the animals. We usually tested only 4 or 5 Dungeness crabs in each tank, whereas as many as 8 or 10 small flatfish were tested in one tank. We also made periodic checks of the dissolved oxygen in the tanks to assure that the level did not fall below accepted minimum standards for the species being tested. Our test duration varied from 10 minutes for the higher temperatures to 48 hours for the lower temperatures.

COST

Our total cost of assembling the mobile water temperature test laboratory does not include the cost of either the towing tractor or the van because both were acquired through government surplus channels at no expense to our agency. An approximate cost of the various components is given in Table 1.

APPLICATION

The mobile laboratory has been used in tests to determine the upper lethal temperature limits for the Dungeness crab and two species of flatfish, English sole and rock sole. The primary purposes of the experiments conducted thus far were to test the operation of the systems designed into the van and to determine the feasibility of using it as an on-site laboratory. Under test conditions, the various systems functioned well. It would be possible to move the laboratory to any site on Puget Sound accessible by road, to set it up and have it operating within 2 or 3 days with a crew of 3 or 4. If commercial electricity were not available at the test site an alternate source, such as a portable motor generator, would have to be provided.

Table 1.—Approximate cost breakdown of the various components of the mobile water temperature testing laboratory.

Components	Price
Stands for test tanks and reservoirs: 3 @ $150 ea.	$450
Test tanks: 12 @ $50 ea.	600
Reservoirs: 2 @ $350	700
Submersible heaters: 3 @ $150	450
Chiller: 1 @ $7,500	7,500
Electrical components (service box, relays, wiring, lights, receptacles, etc.)	500
Plumbing (pipe, valves, hoses)	500
Pumps: 2 @ $275 ea.	550
Total	$11,250

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NOAA/NMFS Developments

Fish Protein Concentrate Data Published

A reference package providing easy access to 12 years of research which resulted in a high-quality, low-cost protein concentrate from fish has been published for public use by the National Oceanic and Atmospheric Administration's National Marine Fisheries Service. Fish Protein Concentrate (FPC) is produced by removing from fish essentially all of their fat and moisture. This yields a high-protein concentrate that possesses unique nutritional value as a food supplement.

From 1961 to 1973 the Commerce Department agency engaged in and sponsored research which developed information on the production and use of FPC. The FPC Information Package will provide the user, whether scientist, commercial investigator, or layman, with documentation of that research.

To simplify finding information in the package, it has been divided into four parts, the first three of which are in print, and the fourth on microfilm. The printed and microfilm portions of the package are available separately, or may be ordered together.

Part 1 provides a summary statement for each of six categories: General, Product Characteristics, Product Uses, Industrial/Economic Aspects, Laboratory Processes, and Production Processes. The summary statement for each category includes an overview of the data and information available in that category, the work pursued by NMFS, significant successes and failures, and, where appropriate, recommended future investigations and follow-up work.

Part 2 is the selected NMFS FPC Bibliography, listed by title, author, type of document, and call number. Included are published and unpublished articles and manuscripts; contractor final reports and, if significant, interim reports; internal NMFS reports and memoranda; and, miscellaneous titles from speeches, papers presented at various conferences, and other materials.

Part 3 of the report contains abstracts of selected documents considered to be of particular significance in the FPC Program. The microfilm portion of the FPC Information Package represents Part 4: Selected Documentation. Documents determined to be of prime importance, particularly with regard to their detailed contents, have been microfilmed in their entirety.

The Fish Protein Concentrate Information Package may be ordered from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The paper copy of Parts 1, 2, and 3, Order No. PB245-345, is $8.75, with a foreign rate of $11.25 (microfiche is $2.25, foreign rate is $3.75). The microfilm portion, Part 4, may be obtained on a 16mm plain reel for $6.00 (Order No. PB245-346) or a cartridge for $8.00 (Order No. PB245-347). Recordak, 3M, or Thread-easy should be specified.

Foreign Fishery Developments

Shrimp Gains Expected by Indonesia and Thailand After Early 1975 Catch Declines

The Indonesian shrimp catch reportedly declined in the first quarter of 1975, according to the U.S. Embassy, Jakarta, and Indonesian Government and shrimp industry sources believe that later shrimp catches were also below 1974 catch levels; precise statistics were not available. Indonesian Government data, however, understate the actual amount of shrimp caught in waters claimed by Indonesia because foreign trawlers operating there without Indonesian permission do not report their substantial catches.

OVERFISHING CITED

According to government and industry sources, the 1975 catch decrease was caused by overfishing in the Arafura Sea (see map), Indonesia's major source of export shrimp. In the Arafura Sea, as many as 80 to 100 foreign shrimp trawlers, a large number for that area, have been fishing under an agreement with the Indonesian Government. Most of these trawlers are Japanese owned. In addition, one industry source estimates there may be as many as 100 additional foreign shrimp trawlers, many of them from Taiwan and South Korea, operating without the Indonesian Government's permission[1]. The average size of shrimp, as well as the total catch, has been smaller in 1975, reinforcing the overfishing theory. Another possible reason for reduced catch was the lower water temperature in the Arafura Sea last year, which may have limited shrimp reproduction.

Indonesia has only an estimated 1,500 metric tons of shrimp cold-storage capacity, and most companies transport shrimp from shore facilities promptly. A few companies still transfer shrimp

[1]The Indonesian government regards these waters as Indonesian territory, in accordance with its claim to the Archipelago Concept of sovereignty over inter-island waters. The claim is not generally recognized by other states. The foreign companies which operate under agreement with the Indonesian Government acknowledge Indonesian rights.

from trawlers to refrigerated carriers for direct shipments abroad, although government policy requires that shrimp be landed to ensure an accurate check of the catch and proper assessment of the full tax levy (now US$50 per metric ton plus income taxes). Indonesian inventories of frozen shrimp were therefore believed to be insignificant last summer.

Indonesian shrimp exports in the first quarter of 1975 declined to 5,800 metric tons from 8,800 metric tons during the same period in 1974, or by 35 percent. The estimated total 1975 shrimp exports thus was expected to be considerably less than the record 33,200 metric tons exported during 1974. Projections based on first quarter exports, however, may not be entirely accurate since in most past years, shrimp catches have increased sharply during September, October, and November.

Shrimp exports to the United States virtually ceased in January 1975 (3 metric tons) and February (6 metric tons) because several shipments destined for the United States in late 1974 were infested with salmonella and rejected for failure to meet U.S. Food and Drug Administration (FDA) standards. Exports to Japan during the same months were: January, 1,895 metric tons and February, 1,890 metric tons. The Directorate of Fisheries was concerned about FDA rejections and introduced compulsory training courses for shrimp processing personnel from all companies. Directorate sources claim that courses have helped to overcome cleanliness problems, and that normal exports to the United States had resumed. No figures were available for the total 1975 exports to the United States when this report was written. The FDA problem and the decline in exports, however, indicate that total exports to the United States in 1975 will be substantially lower than the 3,000 metric tons exported to the United States in 1974.

Notwithstanding the early 1975 decline in shrimp exports, Indonesian Government and shrimp industry sources predicted continued growth in shrimp exports in the future. Such exports increased 181 percent by quantity between 1968 and 1974, and the potential for further growth is believed to be great. Japan will probably continue to be the largest consumer of Indonesian shrimp (Tables 1 and 2) because of the dominant Japanese position in fisheries investment and because shipping costs to Japan are far lower than similar costs of transporting shrimp to U.S. markets.

Table 1.—Indonesian shrimp exports by value (in millions of U.S. dollars), 1971-1974.

Year	To U.S.	To Japan	To other countries	Total
1971	NA[1]	NA	NA	14.7
1972	2.5	23.9	3.4	29.8
1973	3.3	50.7	3.6	57.6
1974	7.3	71.1	6.1	84.5

[1]NA—not available

Table 2.—Indonesian shrimp exports by quantity (in 1,000 metric tons), 1971-1974.

Year	To U.S.	To Japan	To other countries	Total
1971	NA[1]	NA	NA	15.3
1972	1.6	17.9	3.9	23.4
1973	1.6	23.9	3.3	28.8
1974	3.0	25.4	4.8	33.2

[1]NA—not available

According to the NMFS Office of International Fisheries, U.S. import data confirms that shrimp imports from Indonesia in the first four months of 1975 decreased drastically from the same period in 1974 (Table 3).

Table 3.—U.S. shrimp imports from Indonesia, January-April 1974 and January-April 1975[1].

Shrimp import	January-April 1975		January-April 1974	
	Quantity[2]	Value[3]	Quantity[2]	Value[3]
Frozen				
Shell-on	25	114	375	1,769
Peeled	145	344	754	1,613
Canned	0	0	25	66
Breaded	0	0	0	0
Total	170	458	1,154	3,448

[1]Source: U.S. Department of Commerce, Bureau of the Census, *U.S. Imports for Consumption*, IM 146, April 1974 and April 1975.
[2]Data in metric tons.
[3]Data in US$thousands.

THAI SHRIMP PICKS UP

Thai shrimp catches and landings were lower in early 1975 due to increased costs of diesel fuel and the decline in the market price of shrimp, according to the U.S. Embassy in Bangkok. After April 1975, the price of shrimp in foreign markets began increasing. This development provided the incentive for greater efforts in the shrimp fishery. In June, shrimp catches reached their former normal levels of more than 4,000 metric tons per month; they were expected to reach even higher levels during the peak months of September and October if prices in foreign markets remained firm.

Thailand exports 25-33 percent of its shrimp catch. The Marine Products Association of Thailand estimated that late summer frozen shrimp inventories were below 100 metric tons. This low inventory level was due both to recent large exports caused by higher prices and to the state of export contracts, which were booked through September. The Association expected Thailand's shrimp exports to the U.S. to equal or exceed 1974 levels (Table 4) despite strict American import standards. Exports to Japan were expected to grow because of strong market demand there for shrimp.

Table 4.—Preliminary Thai customs figures for total shrimp, prawn, and lobster exports to the U.S. January-June 1975[1].

Month	Total Exports		Exports to U.S.	
	Quantity[2]	Value[3]	Quantity[2]	Value[3]
Jan	899	2.42	130	0.40
Feb	1,027	2.86	125	0.40
Mar	984	2.32	120	0.40
Apr	1,058	6.67	137	0.44
May	977	2.42	80	0.30
June	1,007	2.77	114	0.40
Total	5,952	19.46	706	2.34

[1]Source: U.S. Embassy, Bangkok. Shrimp comprise the vast bulk of the total export figures.
[2]Data in metric tons.
[3]Data in US$millions.

ICELAND REPORTS FISH STOCK STATUS

The Office of International Fisheries, NMFS, has received a summary of the status of fishery stocks in Iceland prepared by the Marine Research Institute (MRI) of Iceland. The report recommends that all foreign fishing on Iceland's fishing grounds be halted, and that the catch of bottomfish species be eventually increased from its current annual average of 0.7 million metric tons to 0.85 million metric tons, through proper fisheries management.

The report was prepared just after Iceland extended its fisheries jurisdiction to 200 miles on 15 October 1975. The MRI believes that under the new regime, the Icelanders will gain full control over utilization of fishery stocks on the fishing grounds around the island. Iceland's concern is understandable: its fishery exports represent 75 percent of Icelandic foreign exchange and imports are equal to almost 50 percent of Iceland's Gross National Product.

It is agreed in Iceland that the MRI report will greatly influence Iceland's position in the forthcoming negotiations with nations who wish to continue traditional fisheries within the newly established 200-mile zone. The following countries fish off Iceland: United Kingdom (U.K.), USSR, Norway, Spain, France, Federal Republic of Germany (FRG), Poland, and the Faeroe Islands, but only U.K. and FRG harvest significant amounts. The recommendations of the Marine Research Institute for individual species are given below.

Cod. The annual cod catch from Icelandic waters for the past 20 years has been 0.4 million metric tons, and this can eventually be raised to 0.5 million metric tons. However, the catch in 1974 was 375,000 metric tons, and MRI recommends 1) reducing cod fishing by 50 percent, 2) no fishing for 3 year-old or younger cod, and 3) substantially reduced fishing for 4-year-old cod. MRI predicts that if catches of 340,000 to 360,000 metric tons are harvested for the next 2-3 years, the stock will decline drastically, and recommends a limit of 230,000 metric tons of cod in 1976 and a minimum size of 50 centimeters (cm). The report notes that 37 percent of Icelandic cod was taken by foreign fishers.

Haddock. The maximum sustainable yield (MSY) is estimated to be 70-75,000 metric tons for Icelandic waters, but the haddock stocks are depleted. A catch of 38,000 metric tons and a minimum size of 45 cm is recommended for 1976.

Pollock. Although pollock stocks are known to migrate between shores and stocks are difficult to determine, their MSY is estimated to be around 100,000 metric tons. MRI recommends a 1976 catch of 75,000 metric tons and a minimum size of 50 cm. Icelanders caught 50 percent of the pollock landed from their waters in 1971-73.

Perch. A catch of 50-60,000 metric tons is recommended, although catches for the last 3 years have averaged 70,000 metric tons. Since foreign vessels take 62-65 percent of the total catch, the report suggests the stocks could soon yield catches of 80,000 metric tons if foreign vessels are banned from this fishery.

Greenland halibut. Catches declined from 34,700 metric tons in 1970 to 20,100 metric tons in 1973 and this species is currently considered to be overfished. MRI recommends a catch of 15,000 metric tons for 1976, predicting a stable catch of 20,000 metric tons when the stock has recovered. It is also suggested that a ban on fishing in the spawning area between Iceland and Greenland, from April to June, would help the stocks. Icelandic fishers landed only 2,100 metric tons of Greenland halibut in 1973 compared to 7,300 metric tons in 1970.

Herring. A total prohibition against herring fishing, except with gill nets, was in effect from the end of 1971 until September 1975. The summer spawning stock has apparently recovered, but no recovery can be seen in the spring spawning herring stock. A total catch of 15,000 metric tons and a minimum size of 27 cm was recommended for 1976. Fishing for this species is allowed only from 15 September to 15 December, and use of mid-water trawls is not allowed.

Capelin. MRI estimates that only 10 percent of the capelin spawning stock is caught each year, and thus placed no restrictions on catches. The report describes the growth of capelin, and estimates that 2- and 3-year-old fish reach their optimum development (10 percent body fat) each August.

The report also has brief descriptions of Norwegian pout, catfish, plaice, shrimp, lobster, and scallops. There is also a section dealing with recommendations on fishing operations which lists restrictions on areas, seasons, and gear. A copy of the entire 12-page report may be obtained by sending two pre-addressed mailing labels, or a self-addressed stamped envelope to: R. V. Arnaudo, Office of International Fisheries (F41), NMFS, NOAA, Commerce, Washington, DC 20235. (Sources: *Morgunbladid* and *News from Iceland*.)

Japan Lists 1974 Fish Product Value

Japan's gross fisheries product value in 1974 recorded an all-time high of 1,738,616 million yen (US$5,975 million at 291:1) up 17 percent from the 1973 figure of 1,490,344 million yen, according to the annual statistics released by the Ministry of Agriculture and Forestry. The 1974 growth rate over the preceding year of 17 percent in fisheries product value was ahead of the 1971 rate of 12 percent and the 1972 rate of 7 percent, but was behind the 1973 rate of 22 percent.

Value of 1974 Japanese fishery products.

Type of fishery	Value of catch: Million yen	Value of catch: Million US$[1]	Comparison (%) 1974 over 1973
High Seas	462,979	1,591	107
Offshore	516,856	1,776	137
Coastal	394,823	1,357	114
Freshwater	34,843	120	117
Shallow-water culture	232,403	799	103
Freshwater culture	63,991	220	121
Whaling	32,721	112	125
Total	1,738,616	5,975	117

[1]Based on 291 yen equals US$1.

Comparing between fisheries types, the highest growth in 1974 occurred in the offshore fishery (37 percent), which has now replaced the high-seas fishery as the nation's dominant fishery in terms of product value. The 1974 tuna landings, worth 302.7 billion yen and up 18 percent from the 1973 value, recorded the highest value of all the fishes caught. (Source: *Suisan Tsushin* and *Suisan Shinbun*.)

Canada Reopens Ports to Soviet Fishing Vessels

Canadian officials have announced that Soviet fishing vessels were again free to use Canada's Atlantic coast ports effective 29 September 1975. They were closed on 28 July 1975, in a successful attempt to attract high-level Soviet attention to fisheries problems. As a result, delegations from both countries met in Ottawa in August and a memorandum of understanding was signed on 27 August 1975. On 26 September, External Affairs Minister MacEachen met with Soviet Foreign Minister Gromyko, and after the meeting, the following Canada-USSR joint communique was issued: "The Minister of State for Fisheries of Canada, the Honorable Romeo LeBlanc, and the First Vice-Minister of Fisheries for Union of Soviet Socialist Republics,

Mr. V. M. Kamentsev, announced today that officials of the Canadian and Soviet Governments have elaborated a bilateral ad referendum agreement on fisheries matters."

The agreement will now be referred to the two governments for their consideration and approval. It provides for the establishment of a Canada/USSR "Joint Fisheries Consultative Commission" and the appointment of a Soviet fisheries official in Halifax. These arrangements are intended to strengthen bilateral fisheries cooperation in the northwest Atlantic between the two countries.

Kamentsev expressed satisfaction with these developments. He stated that the USSR supports the principle of rational, scientifically-based utilization of fishery resources and shares Canada's concern regarding the urgent conservation needs of the fish stock of the northwest Atlantic, and indicated that the Soviet delegation supports Canada's proposals for a reduction in fishing effort and lower total allowable catches for certain stocks of ground fish in critical condition, as well as appropriate allocations of allowable catches among countries. These proposals are being considered by the International Commission for the Northwest Atlantic Fisheries (ICNAF).

In accordance with agreed record of understanding issued after the Canada/USSR fisheries talks of 25-27 August 1975, LeBlanc and Kamentsev reaffirmed the readiness of the two governments to have their officials meet at an early opportunity in order to consider the elaboration of a further bilateral agreement on fisheries cooperation.

The NMFS Office of International Fisheries reports that Canada's External Affairs Minister MacEachen was quoted as calling the agreement "the most important single development in the fisheries field that we have been working on yet." The Canadians obviously feel that the Soviets have negotiated in good faith, since they have reopened their ports without waiting for the Soviets to implement their pledges.

During late summer, the Canadians conducted successful bilateral fisheries discussions with Spain, Portugal, Norway, and Poland (see related article, right) over matters of resource conservation and fisheries jurisdiction. Brief reports on the results of these discussions are available through the NMFS Office of International Fisheries, NOAA, Commerce Department, Washington, DC 20235.

EEC IMPORT, EXPORT LEAFLETS AVAILABLE

The Intervention Board for Agricultural Produce in the United Kingdom has published a series of "Explanatory Leaflets to the Trade" on the European Economic Community (EEC) system of import and export licensing, import levies, and export refunds. Those leaflets that may be of interest to the fishing industry include: The General System, LR1; Pre-financing of Export Refunds, LR2; Fish, LR16.

People interested in obtaining any of these publications should write to the Intervention Board for Agricultural Produce, P. O. Box 69, Fountain House, 2 West Mall, Reading RG1 7QW, Berkshire, United Kingdom.

Canada Talks Fisheries with Poland and Norway

Canada continued to hold bilateral fishery discussions with nations that fish off its coasts last year, as L. H. Legault, Director General of International Fisheries and Marine Directorate, Fisheries and Marine Service met with Norwegian officials in Oslo on 15-16 September and Polish officials in Ottawa on 19 September. Canada and Poland discussed the drafting of a bilateral fisheries agreement concerning Polish fishing off Canadian coasts, referring to possible "anticipated legal and jurisdictional changes in the regime of fisheries management in such waters. . . ." In addition, short-term arrangements regarding Polish fishing off the Pacific Coast were discussed, and further talks were scheduled for the September ICNAF (International Convention for the Northwest Atlantic Fisheries) meeting.

Legault had met with Norwegian officials earlier in the week of 15-16 September to discuss fishery matters of mutual concern, including "the welfare of their coastal communities and the rational management, conservation, and utilization of the living resources of their coastal waters." The two sides also agreed to enter into formal bilateral negotiations at an early date on the subject of Norwegian fishing off Canada. Finally, both sides recognized that "urgent and effective action" is needed to preserve fisheries, and that both Norway and Canada, as coastal states, have "special rights and obligations in respect of the conservation and management of the living resources in areas beyond and adjacent to waters now under their fisheries jurisdiction, in accordance with the consensus now emerging from the United Nations Law of the Sea Conference." Norway emphasized that a substantial reduction in the fishing effort is needed in both the ICNAF and NEAFC (Northeast Atlantic Fisheries Commission) areas. (Source: U.S. Embassy, Ottawa.)

PRC Fishery Delegation Sees Canadian Facilities

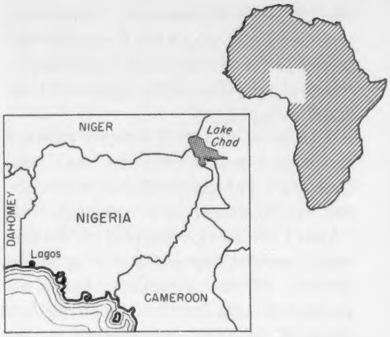
An eight-man fisheries delegation from the People's Republic of China arrived in Canada 5 September as part of an exchange program between the two countries, Environment Canada reports. The delegation visited Ottawa and other regions of Canada during its 18-day stay. A Canadian Government fisheries and marine delegation visited China in November-December 1974.

The PRC delegation was headed by Hsiao Feng, Director, Aquatic Products Bureau, Ministry of Agriculture and Forestry. He is one of the highest ranking Chinese officials to come to Canada under the series of exchanges initiated during the Prime Minister's visit to China in 1973.

During their stay in Canada the delegation visited Halifax, Ottawa, Burlington (Ontario), Winnipeg, and Vancouver, with various stops along the way to tour Federal Fisheries and Marine Service institutions and other Canadian facilities and programs of interest.

Other members of the delegation included: Yang Tso-sheng, Ministry of Agriculture and Forestry; Wang Chan-li, Ministry of Agriculture and Forestry; Ting Jen-fu, Shanghai Aquatic Products Institute; Yu Chin-tang, Aquatics Research Institute; Su Kuang-chien, Chan Chiang Cement Boat Factory; Sung Chih-wen, Ministry of Agriculture and Forestry; and Chang Chin-fei, Ministry of Agriculture and Forestry.

Nigeria Releases Fishery Expansion Details



The Federal Military Government has released details of Nigeria's Third National Development Plan (1975-1980). The entire plan provides for a total investment of US$54.4 billion[1] for all public sector projects, of which US$168.1 million will be invested in fisheries[2]. The projects envisioned under the Plan represent a number of opportunities for U.S. firms in the areas of aquaculture, artisanal and marine fisheries, processing, marketing, training, and research, according to the NMFS Office of International Fisheries.

Several factors have hindered rapid development of Nigeria's fisheries. Capital for the purchase of fishing vessels, modern gear, and cold-storage facilities have traditionally been unobtainable by Nigerian fishers due to lack of credit. In addition, Nigeria has inadequate port and shipyard facilities and a poor transportation network in both coastal and inland fishing areas, which seriously affects the marketing of fish. Finally, development of Nigeria's fisheries has been impeded by a shortage of trained manpower and the lack of effective organization among artisanal fishers.

To improve these conditions, the new National Development Plan sets the following goals: 1) Increase domestic fish production to meet local demand, 2) Earn foreign exchange through increased shrimp exports, 3) Encourage the local production of fish meal and dryed fish to conserve foreign exchange and provide employment, 4) Increase the catch and income of artisanal fishers.

Nigeria is attempting to increase domestic fisheries catch by almost 1.2 million metric tons by 1980 (Fig. 1, Table 1). This represents an increase of 44 percent over the 1973 catch, the last year for which statistics on the actual catch are available.

The Nigerian Government believes that it is possible to obtain this large increase because Nigeria is rich in marine and freshwater fisheries resources, having over 800 kilometers of coastline, extensive brackish water lagoons and creeks, rivers, and lakes including Lake Chad (see map), and man-made lakes such as Lake Kainji.

The domestic demand for fish is currently estimated at over one million metric tons. By 1980, the demand for fish is expected to exceed 1½ million metric tons. Even if projected catch increases (Table 1) are realized, the Development Plan indicates that by 1980 Nigeria will still need to import an annual total of 450,000 metric tons of fish (Fig. 2), principally dried cod[3].

Table 1.—Actual and projected Nigerian fisheries catch and imports. Data for 1970-1973 (actual) is from the *FAO Yearbook of Fishery Statistics*; data for 1974-1980 (projected) is from the Nigerian Third National Development Plan.

		Imports[1]		
Year	Catch[1]	Dried Cod	Other	Total
1970	543	—	—	—
1971	593	—	—	—
1972	646	—	—	—
1973	666	—	—	—
1974	700	105	95	200
1975	740	250	100	350
1976	818	260	110	370
1977	895	270	120	390
1978	985	280	130	410
1979	1,085	290	140	430
1980	1,190	300	150	450

[1]Data in thousands of metric tons.

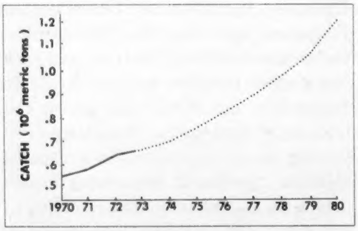


Figure 1.—Nigerian fisheries catch: 1970-1973 data from FAO Yearbook of Fishery Statistics; 1974-1980 data projected in Nigerian Third National Development Plan.

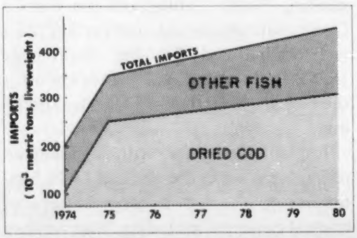


Figure 2.—Nigeria's projected fishery imports under Nigerian Third National Development Plan.

The National Development Plan's fisheries subsector is organized into a number of basic areas: aquaculture, artisanal and marine fisheries, infrastructure (processing and marketing), port facilities, training, and research.

The Plan envisions utilizing the vast area of water which will be created by the proposed irrigation dams and canals for aquaculture. The reservoirs will be stocked by five new breeding centers/hatcheries, each with an area of 99 acres. A number of state governments will also establish fish ponds to supply fish fry and fingerlings for stocking purposes.

Marine fisheries are another important aspect of the Development Plan. Both state and federal agencies will take an active role in the shrimp industry. Shrimp fishing has boomed in recent years, after the discovery of abundant stocks of red deep-water shrimps in resource surveys and experimental fishing ventures carried out by joint Japanese-Nigerian companies. The Nigerian Government proposes to increase shrimp exports 400 percent by 1980. The 1973 export of over 1,350 metric tons is expected to increase by 1980 to about 5,500 metric tons per year, the estimated maximum sustainable yield from the Nigerian shrimping grounds. A government study estimates that at recent average wholesale shrimp prices, Nigeria could earn US$25.6 million annually from shrimp exports by 1980.

As a result of the Nigerian indigenization policy[4], licenses for chartering foreign-owned trawlers[5], which at pres-

[1]All U.S. dollar figures are based on a currency conversion ratio of 0.6062 Naira to the dollar.
[2]Not included in the fisheries section of the Plan are industrial projects related to fish and shrimp trawling and distribution and fish canning which total an additional US$49 million.

[3]Dried cod is commonly referred to in Nigeria as "stockfish."

[4]The Nigerian Government has taken measures to encourage the development of Nigerian-owned businesses, place Nigerians in all levels of employment and administration, and limit foreign activity to certain fields.
[5]About 100 such vessels, ranging between 1,000 and 6,000 gross tons, are currently licensed.

ent dominate Nigerian distant water fishing, will be reduced or phased out. Federal and state-owned companies, as well as Nigerian private industry aided by government financing, will take over deep-sea fishing. Orders for some deep-sea trawlers have already been placed.

Joint state-federal projects will stimulate development of an intermediate stage between primitive canoe fisheries and advanced deep-sea fisheries by introducing 50 medium-sized fishing vessels for coastal fishing[6], at a cost of US$9.9 million. The development of a shallow-water fishing craft capable of beach landing in remote areas is also projected.

The artisanal fisheries program will provide modern fishing nets and gear, seaworthy boats with outboard motors[7], and facilities for servicing engines. This program will also introduce and promote better methods of processing and marketing fish. Fishers will be encouraged to organize into cooperatives through credit assistance. The Federal government alone plans to spend over US$18.1 million to assist artisanal fishers.

In a program to correct processing and marketing deficiencies which result in high spoilage rates[8], Federal and state agencies will provide almost US$10 million in assistance through fishing cooperatives. These funds will be used for the construction of cold storage facilities, smoking kilns for use in remote areas, fish drying plants, dry storage and marketing sheds, and for the purchase of refrigerated trucks and barges.

Significant expansion of fisheries port facilities is envisioned in the Plan, at a cost of US$16.7 million. The construction of a distant-water fishing terminal on Tin-Can Island near Lagos has been given high priority. When it is finished, all other fishing terminals in the Lagos Port area will be closed. Additionally, the Plan envisions feasibility studies and construction projects for fishing ports in other areas of the country.

[6]Apart from shrimp trawlers, the Nigerian coastal fleet is at present composed of 30 vessels, ranging from 20 to 265 gross tons. The catch consists of 10 principal species of fish, of which croaker is the most important.

[7]Replacing 2,000 canoes.

[8]Significant quantities of fish spoil due to the crude smoking processes used by artisanal fishers, inadequate transportation, unsanitary storage, improper handling and refreezing of thawed fish. The Nigerian Government believes that spoilage currently exceeds 50 percent in remote areas.

The Plan also provides for manpower training and research projects. The Federal government plans to expand the existing fisheries school and establish a new freshwater fisheries school. A new research vessel will be purchased at a cost of US$990,000. The new vessel will provide for longer range investigations in deeper water and more distant areas than is possible with the government's existing vessel. Other research projects include pollution monitoring, development of an economical means of converting unsaleable fish into protein concentrate, conversion of fish and shrimp wastes to livestock feeds, aquaculture, and marketing studies.

U.S. firms interested in investigating business opportunities in Nigeria should contact the Economic/Commercial Section, U.S. Embassy, Lagos, c/o U.S. Department of State, Washington, DC 20520. Copies of the fisheries section of the Development Plan may be requested from the Country Marketing Manager, Central Western Africa, OIM/BIC, U.S. Department of Commerce, Washington, DC 20230.

Iceland, UK Argue Fishing Zone Rights

Iceland extended her fisheries zone from 50 to 200 miles on 15 October 1975, becoming the first European nation to declare such a zone. Iceland first extended her fishing limits from 3 to 4 miles in 1952, then to 12 miles in 1958, and finally to 50 miles in 1972. In the spring of 1975, the Reykjavik Government announced that fish stocks continued to be overfished (Fig. 1), and that as a result Iceland would extend her fisheries zone to 200 miles.

Iceland receives approximately 75 percent of its foreign exchange from fisheries trade, and since imports are equal to about one-half of its GNP, the fishing industry is vital to the well-being of the economy. The Icelandic Government feels that the best way to protect the country's fish stocks, a prime natural source, is to extend the fisheries zone.

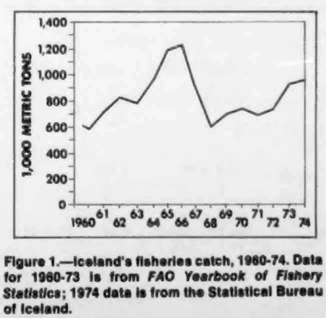


Figure 1.—Iceland's fisheries catch, 1960-74. Data for 1960-73 is from *FAO Yearbook of Fishery Statistics*; 1974 data is from the Statistical Bureau of Iceland.

The United Kingdom, which fishes heavily in the waters which Iceland now claims, and has repeatedly had difficulties with fishing rights in the waters claimed by Iceland, has recently angered the Icelandic Government over the issue of 200 miles. In a 4 October speech on British fishing rights, the U.K. Secretary of State for the Environment, Anthony Crosland said British fishers would continue to fish in Icelandic waters even without a new U.K.-Iceland fisheries agreement. The old agreement expired on 13 November. Reaction by Iceland's leadership was swift and negative.

Prime Minister Geir Hallgrimsson said "obviously we maintain that the British have no right to fish inside 200 miles after the 15 October extension in absence of agreement with us. We expect to negotiate with the British and determine how much they want an agreement. If they don't want one any more than Crosland's remarks indicate, then it is unlikely that one will be reached." Fishery talks between Iceland and the U.K broke up on 17 November without agreement. The UK is asking for an annual catch of 110,000 metric tons in Icelandic waters and Iceland has been offering 65,000 metric tons.

West Germany, on the other hand, has recently taken steps to ease its ongoing dispute with the Iceland Government. The two countries have had several rounds of talks and the Bonn Government has agreed to lift the ban on Icelandic landings of fish in German ports which has been in effect since the spring of 1975. Additionally, the Germans have promised to discuss the issue of implementing the EEC tariff reductions, which were agreed upon in 1972 but have yet to be put into effect. German Minister of State Wischnewski held talks with Iceland's Foreign Minister Agustsson in Reykjavik last fall and the two nations reached a settlement, which was ratified by the Icelandic Parliament on 28 November 1975. (Sources: U.S. Embassy, Reykjavik; Radio Hamburg; Radio Cologne.)

European Community Fishery Data Listed

Fishery-related items published in the *Official Journal of the European Communities*, January-July 1975, included carp reference prices, hake guide prices, fixing export refunds, determining entry prices, aid for private storage, withdrawal prices, protective measures on importing tuna, loans for modernization, extension of territorial waters establishing fishing zones, common fisheries policy, and others. The *Journal* is the official register of EC regulations and policies.

Copies of these regulations, listed below in detail, and any additional information on them, are available from:

Fred Olson, Office of International Fisheries (F4) U.S. Department of Commerce, NOAA, NMFS, Washington, DC 20235.

Fishery Products		Official no	Journal page
1. Carp			
fixing reference prices for 1975/76 marketing year	R (EEC) 1750/75	L178	17
2. Certain fats and oils of fish and marine mammals imports into Denmark, Ireland and United Kingdom from other Member States temporary suspension of customs duty authorizing	R (EEC) 1919/75	L 195	22
3. Common fisheries policy in the North Sea 369/74 by Mr. Brewis to the Commission of the EEC	(Written questions with answers)	C 3	11
4. Common organization of the market supplementing R (EEC) 2142/70	R (EEC) 1182/75	L 118	1
5. Determination of wholesale markets and representative ports amending Annex to R (EEC) 1109/71	R (EEC) 1244/75	L 125	20
6. Entry price			
detailed rules for determining supplementing R (EEC) 1109/71	R (EEC) 1196/75	L 118	28
amending R (EEC) 1109/71	R (EEC) 1052/75	L 104	14
7. Fishery products			
a. aid for private storage			
laying down detailed rules for the granting	R (EEC) 1647/75	L 165	56
setting up a temporary system	R (EEC) 1629/75	L 165	14
" "	Opinion EP	C157	11
b. export refunds	R (EEC) 804/75	L 78	71
fixing	R (EEC) 1575/75	L 161	12
8. Guide price			
hake			
fixing for 1975 fishing year	R (EEC) 1183/75	L 118	2
supplementing R (EEC) 3559/73	R (EEC) 1242/75	L 125	17
9. Hake			
guide price—R (EEC) 1242/75	Corrigendum	L 177	24
10. Importation into the Community of certain fishery products			
originating in Tunisia	R (EEC) 346/75	L 40	1
" in Morocco	R (EEC) 347/75	L 40	3
	Opinion EP	C 32	33-34
11. Protective measures in respect of the importation of certain fishery products	Corrigendum to R (EEC) 460/75	L 51	15
amending R (EEC) 460/75	R (EEC) 700/75	L 69	15
extending the period of validity	R (EEC) 974/75	L 94	18
tunny for industrial manufacture extending the period of validity of R (EEC) 460/75	R (EEC) 1245/75	L 125	21
12. Reference prices - 1975 fishing year			
amending R (EEC) 3326/74	R (EEC) 1051/75	L 104	13
fixing for 1975 fishing year amending R (EEC) 3326/74	R (EEC) 1195/75	L 118	26
13. Standard values			
fishery products withdrawn from market altering	R (EEC) 887/75	L 85	25
14. Tunny for industrial manufacture protective measures - imports extending the period of validity amending R (EEC) 460/75	R (EEC) 1682/75	L 168	75
15. Withdrawal price and reference prices			
hake—Annexes I (A) and IV (B) to R (EEC) 2142/70	R (EEC) 1243/75	L 125	19
fixing for 1975 fishing year	" "	"	"
Fishing			
1. Loan from European Investment Bank for modernization of French sea fishing fleet	WQ 735/75	C 122	17
2. Norwegian territorial waters proposed extension, question 13 to the Commission of the EC by Mr. Brewis	(Questions to the EC Council)	C 80	28
Fishing zones			
1. Establishment of fishing zones by Norway exchange of letters	Prop.	C 99	5
" "	Opinion EP	C 128	37

Malagasy Republic Lists 1974 Fish Product Sales

The Malagasy Ministry of Rural Development has issued a publication entitled "Commercialisation controlée des produits marins et capture des differentes sociétés" (A Marketing Analysis of Marine Fishery Products and the Catch of Different Companies). Data on fisheries exports in 1974, broken down by port of embarcation is included. A summary of this export data, detailing the quantity of Malagasy fishery product exports by type of product, is presented in tabular form below.

Malagasy exports of fishery products, 1974.

Product	Metric tons
Fish	
Fresh	10,071.4
Salted and dried	173.3
Crustaceans	
Shrimp	
Fresh and frozen	4,579.5
Boiled	0.7
Dried	20.5
Meal	0.7
Crab	
Live	6.5
Frozen	10.9
Spiny lobster	
Live, whole and frozen	87.2
Frozen tails	10.0
Cooked, whole and frozen	11.8
Mollusks	
Oyster	0.1
Octopus and cuttlefish	negl.
Shells[1]	16.4
Other	
Turtles	0.6
Sea cucumbers	29.5
Shark fins and meat	12.3
Seaweeds	338.3
Total	15,369.7

[1]Ornamental and mother of pearl.

The rest of the booklet is comprised of tables on fish marketed for immediate local consumption, fishery products shipped outside of the administrative district in which they were caught, and catches of the different fishing companies. Requests for this publication should be directed to: La Direction de l'Elevage et de la Pêche Maritime, Ministère du Developpement Rural, Tananarive, Malagasy Republic.

New Polish Fishery Company Established

A new fisheries production and service organization, Transocean, has been established in Szczecin, Poland, according to the NMFS Office of International Fisheries. It was formed

by fusing the enterprise "Centralia Handlowa Zbytu" (Commercial Center for Marketing) and the anxillary fleet of the Gryf Fishing Enterprise. The primary task of the new enterprise is to receive the catch from the fleet, process it, ship it to Poland, and then transport it by land to the wholesalers. Transocean also provides supplies to the fleet. Its director is Albert Gruzecki.

The Transocean company's fleet consists of two B-67 fishing bases, three B-433 refrigerated ships, and a new vessel named the *Zulawy* which can-transport 6,000 metric tons of fish at a time. The latter has just returned to Szczecin from its maiden voyage with 5,000 metric tons of frozen fish and 1,500 metric tons of fish meal. The *Zulawy* also transferred to foreign vessels on charter approximately 10,000 metric tons of fish meal.

Two more vessels of the Zulawy class, the *Harmatan* and the *Piast*, are operational. Later in the year, Transocean will receive another vessel of this class called the *Wineta*. Three additional Zulawy-class vessels will be built during the next 5 years for a total of 7 vessels of this type.

On land, the new enterprise presently has more than 250 refrigerated trucks of the Volvo make. The number of such vehicles will increase, and special transport bases will be built within the next 5 years. The Polish fishing industry is planning to catch 1,000,000 tons of fish by 1980. Approximately 700,000 tons will be caught in 1975.

USSR REPORTS CATCH OFF U.S. PACIFIC COAST

The Soviet Ministry of Fisheries has begun to provide the National Marine Fisheries Service with preliminary monthly catch statistics for fishing areas off the U.S. Pacific Northwest and Alaska as stipulated in the U.S.-USSR Agreement on North Pacific Fisheries.

Soviet fishers reported a total catch of 422,579 metric tons for the first eight months of 1975. The hake fishery off Northern California and Oregon provided the largest catch: 154,322 metric tons, or 37 percent of the total. The Alaska pollock fishery in the Eastern Bering Sea and off Alaska was also significant, with a recorded catch of 143,169 metric tons, or 34 percent of the total.

Soviet preliminary fisheries catch off the U.S. Pacific Coast January-August 1975.

Species	Fishing area	Quantity (Metric tons)
Pacific Ocean perch	Aleutians	7,779
	Alaska	6,721
		14,500
Pacific hake	Vancouver, Oregon	29,637
	North California	124,685
		154,322
Alaska pollock	Eastern Bering Sea	117,613
	Alaska	25,556
		143,169
Pacific herring	Eastern Bering Sea	18,351
Other, n.o.s.	Eastern Bering Sea	81,856
	Aleutians	10,381
		92,237
	Grand total	422,579

Pacific ocean perch, herring, and incidental catches of other unspecified fish accounted for the remaining 29 percent. The Soviet fleet has been fishing pollock off Alaska since the beginning of the year; the hake fishery off California began in March 1975. Over 92,000 metric tons of fish were not identified.

According to the NMFS Office of International Fisheries, the Soviet Fleet Commander for the U.S. Pacific coast, Vladimir Filonev, mentioned in a 25 August interview with an NMFS enforcement agent that the Soviets had not taken all of their 150,000-metric tons hake quota this year. Filonev's estimate of the hake catch was slightly below the preliminary 154,322-metric ton total.

USSR Baltic Vessels Irk Swedish, Finnish Fishers

Fishers from the Finnish island of Aaland in the Baltic demonstrated in Helsinki on 3 November to protest destruction of their nets by Soviet trawlers.

The Soviets had been using mid-water trawls to catch sprats which are then taken to fishery kolkhozes in Estonia to

be smoked or processed. Aaland fishers complain that due to Soviet trawling they have lost nets worth tens of thousands of kronor, and that salmon stocks have been disturbed off Bogskaer and Langskaer Islets.

Complaints have also been voiced that the Soviets are violating the new 12-mile Swedish fishing limits off the coast north of Stockholm. However, the new Swedish limit in the Baltic will not apply to the Soviet fishing fleet until 1976. Source: *Dagens Nyheter* (Stockholm).

The NMFS Office of International Fisheries reports that similar gear-damage problems with the Soviet fishing fleet are resolved in Canada, the United States, and Norway through bilateral fisheries claims boards. In Norway, for example, a bilateral claims board was established in January 1960. This board over the last 15 years has considered about 30 cases involving minor damage to fishing gear, all of which have been settled. Payments to Norwegian fishers have totaled approximately US$20,000. The Soviet-Norwegian Claims Board normally meets once a year to consider between two and seven cases; however, under special circumstances it meets more often. Norwegian authorities have apparently been satisfied with the results obtained through the Board.

TAIWANESE VESSEL SEIZED AND FINED

The U.S. Coast Guard seized the Republic of China longliner *Tong Hong No. 3* off Cape Edgecumbe (near Sitka, Alaska) on 9 September for a suspected violation of the U.S. Contiguous Fishing Zone. While the 488-gross ton longliner remained moored at Mt. Edgecumbe, Alaska, under Coast Guard security, legal proceedings began in Anchorage.

Witnesses and documentation for the prosecution of the case arrived in Anchorage on 14 September and were presented to the U.S. Attorney. The owners of the vessel reached an out of court settlement for $205,000, which included a $200,000 civil penalty and a $5,000 criminal fine. The *Tong Hong No. 3* departed U.S. waters on 23 October.

The NMFS Office of International Fisheries reports that the *Tong Hong No. 3* had 7 metric tons of black cod

aboard at the time of seizure. Her home port is Kaohsiung, Taiwan, and the vessel is owned by the Tong Hong Company. The fishing master aboard the vessel at the time of seizure was a Japanese national who carried a business card of the Japanese fishing company, Taiyo Gyogyo Co., Ltd.

An 11 September Associated Press report of the seizure was printed by the *China News*, an English-language newspaper of Taiwan. The *China News* added a statement from a spokesman for the Taiwan Fisheries Bureau who stated that the captain and owners of the vessel would be punished in accordance with the Chinese government's policy to discourage intentional intrusion by Taiwanese vessels into foreign waters. Under Taiwanese law, punishment could include revoking the government-issued fishing license of the vessel for up to one year.

Japanese Stern Trawler Apprehended and Fined

A joint aerial surveillance patrol of the National Marine Fisheries Service (NMFS) and the U.S. Coast Guard (USCG) observed the Japanese medium stern trawler *Eikyu Maru No. 35* within the Contiguous Fishing Zone (CFZ) off Amlia Island, Alaska, on 3 November 1975. The USCG cutter *Jarvis* was alerted and intercepted the *Eikyu Maru No. 35* on 4 November near position 55°9'N, 172°19'W. The Japanese vessel was seized for violating the law establishing the CFZ of the United States.

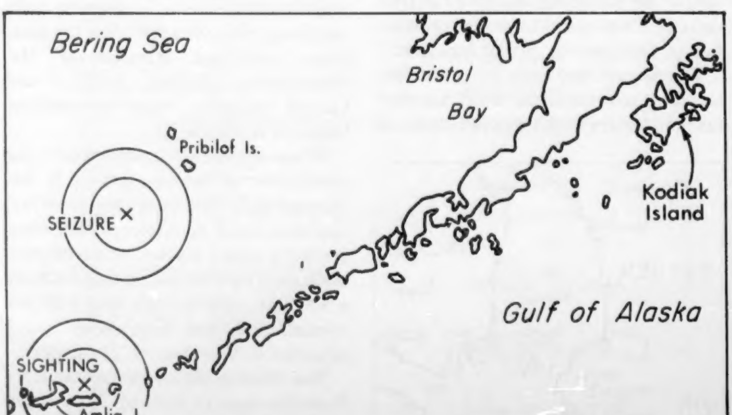
The *Eikyu Maru No. 35* was escorted to Kodiak where the 167-foot trawler was placed under custody of the U.S. Marshall pending the outcome of the case in District Court at Anchorage, Alaska. The owner entered a plea of guilty to the charge and the Court assessed the captain a $25,000 criminal penalty and the owner of the vessel, the Konno Suisan Kabushiki Kaisha (Konno Marine Products Company, Ltd.) of Ishinomaki, Japan a $575,000 civil penalty. The owner agreed to pay the $600,000 fine and the *Eikyu Maru No. 35* departed U.S. waters November 20, 1975. (Source: NMFS Law Enforcement and Surveillance Division.)

According to the NMFS Office of International Fisheries, the *Eikyu Maru No. 35* was built in 1972, is 50.89 meters long and has an estimated value of over $3 million. The 349-gross-ton fishing vessel is equipped with two Loran sets, 2 radars, an Omega system and a navigational computer.

The vessel departed Japan on 27 October 1975, and began bottom trawling off Amlia Island upon its arrival in the Aleutians. Only three hauls were made prior to seizure. NMFS enforcement agents estimated the catch at 10 metric tons of flounders and turbot and 0.5 metric tons of red rockfish and sablefish.

When the aerial patrol ordered the Japanese vessel to stop, its captain disregarded the request, hauled the gear, and got underway. Aerial contact was maintained until the *Jarvis* took over the "hot pursuit." The vessel halted upon reaching the Japanese fishing enforcement vessel *Kona Maru* which advised it to halt. A Japanese law enforcement agent was on board the *Eikyu Maru No. 35* when the U.S. boarding party arrived.

The U.S. Contiguous Fishing Zone Law (16 USC 1091) provides for criminal charges against the master of a foreign vessel fishing within 12 nautical miles of the U.S. coast and also provides for civil charges against the vessel's owner. The fine of $600,000 is the highest on record for a CFZ violation.



Norwegians Propose Coast Guard Unit

An interagency group of the Norwegian Government, headed by the Undersecretary of Commerce T. Stoltenberg, evaluated the national services needed on Norway's Continental Shelf, and on 27 June 1975, recommended the formation of a Coast Guard. The report noted that the ever-increasing offshore responsibilities are distributed among a number of government agencies, and, that as these responsibilities expand in areas such as Continental Shelf exploitation, fishing, navigation, etc., the need for better coordination will grow.

The Stoltenberg Committee studied Coast Guard services in other countries—the United States, the United Kingdom, France, Federal Republic of Germany, Sweden, Denmark, Iceland, and Canada—and decided to transform the present Naval Fisheries Surveillance Service in the Norwegian Ministry of Defense into a Coast Guard. The new agency will be under the authority of the Minister of Defense and will perform an executive and coordinating role for the various services required on the Continental Shelf.

Specifically, the Norwegian Coast Guard will be responsible for: 1) Fisheries surveillance and gear protection, 2) monitoring Continental Shelf activities, and 3) plotting and monitoring drifting objects. It will also help other agencies with rescue services, environmental protection, and police duties. Finally, it will assist other agencies and institutions when there is a need for vessels, aircraft, and helicopters.

The proposed Coast Guard will have a US$21 million budget, to be appropriated separately under the Ministry of Defense. It will employ an estimated

685 persons, and have the following resources: 10 surveillance vessels, one special 200-ton deep-diving support vessel, one submarine, 6 helicopters, and 3 surveillance aircraft. A surveillance ship base will be constructed in north Norway, and an underwater research institute will be established.

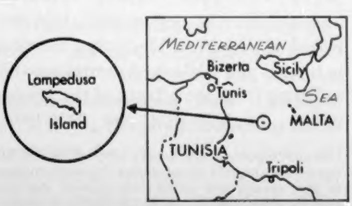
The planning phase for procurement is estimated at one year, with the first vessels to be ready by 1979, and all ships to be operational by 1982-83. The Parliament will consider the Government's proposal in late 1975 or early 1976, and the outlook for passage appears good. (Source: US Embassy, Oslo.)

According to the NMFS Office of International Fisheries, the proposed establishment of a Coast Guard comes in anticipation of the eventual extension of Norway's fisheries limits to 200 miles. Recent statements from Oslo indicate that while the Government is hoping for the Law of the Sea Conference in 1976 to negotiate a settlement to the issue of extended jurisdiction, it is prepared to extend unilaterally to 200 miles if necessary. Whether the Norwegians take this action by themselves or in accordance with the LOS Conference, the proposed Coast Guard will have the responsibility for surveillance of Norway's expanded fisheries zone.

Italy, Tunisia Reach Fishery Agreement

Italy and Tunisia agreed on 20 October 1975 on the licensing of Italian fishers to operate in Tunisian waters and on financial cooperation between the two countries. According to press reports, about 90 licenses will be issued to allow Italian fishing vessels to operate in Tunisian waters after payment of US$4 million. The Tunisians had originally demanded US$12 million. Agreement was also reached on a US$64 million loan to Tunisia for the purchase of Italian goods.

The previous bilateral fisheries agreement, which expired 31 December 1974, was reinstated until 31 December 1975. Negotiations had stalled earlier after the two countries failed to reach agreement on a Tunisian demand that Italy purchase 20,000 tons of olive oil. Tunisia has reportedly used the presence of Italian fishers in Tunisian waters[1] to force Italian concessions on the olive oil issue.



Another long-standing dispute between the two countries concerns Continental Shelf rights in the area between Sicily and Tunisia in which the Italians are fishing. An agreement resolving this issue was signed in December 1974.

Italian fishers have traditionally fished in the waters between Sicily and Tunisia, but Tunisian authorities seized several vessels fishing off Lampedusa, an Italian island located halfway between Sicily and Tunisia (see map). A total of 10 Italian fishing vessels have been seized in the past year. On 4 October 1975, a 19-year-old Italian fisher was killed by shots fired from a Tunisian patrol boat, and the Italian Government lodged a formal protest with Tunisia.

During September 1975, when the dispute reached crisis proportions, the Italian Fishing Federation (Federpesca) exercised strong pressure on the Italian Ministry of Merchant Marine and the Ministry of Foreign Affairs to come to an agreement with the Tunisians which would allow the Sicilian fishers to continue fishing off Tunisia. The matter was finally discussed in the Italian Council of Ministers, while the Italian Embassy in Tunis maintained daily contacts with Tunisian authorities.

Such pressures came at a bad time for Italian fishers, as other African nations have been challenging Italian efforts to fish off their coasts. The NMFS Division of International Fisheries Analysis (F41), Washington, DC 20235, has prepared an article on this subject, entitled "Italian Fishery Negotiations with African Countries" (3 June 1975, #92), which is available upon request.

(Sources: Various Italian and Tunisian news media; *La Pesca Italiana*.)

[1]In 1962, Tunisia claimed an exclusive fishing zone of 12 nautical miles.

Norway Sets Time For Fishery Limit Action

A year at the maximum is the deadline set by Norway in November for reaching a negotiated settlement on a fisheries limits extension, the Norwegian Information Service reports. This was made clear during the first round of substantive talks on this issue currently taking place with a number of European countries. The talks were "useful," the Minister in charge of the fisheries limits question, Jens Evensen, told the Storting. By the end of the year, Evensen's team met with representatives for the Nordic countries, the United Kingdom, France, East and West Germany, Belgium, the EEC Commission, Poland, and the Soviet Union.

Norway made it clear during this first round that she is primarily seeking an economic zone extending up to 200 nautical miles from her coast, Evensen said. The possibility of certain transitional or mutual rights was also indicated. No detailed text of an agreement had been presented, however.

The Norwegian Government, in November, was preparing legislation giving it authority to implement any solution which might be reached, Evensen revealed. Although establishing the 200-mile economic zone as the principle objective, this legislation would not exclude the possibility of more restricted alternatives. Adequate guarantees for the free passage of international shipping would also be provided. Evensen also stressed that Norway has not renounced the possibility of unilateral action if all else fails.

ROYAL NAVY SEIZES SOVIET TRAWLER

A Soviet trawler, the *D. Furmanov*, was seized off the southwest coast of England during the week of October 13 by the Royal Navy minesweeper *Shavington*, the NMFS Office of International Fisheries reports. The *Furmanov* was spotted inside the 12-mile fisheries limit with her gear improperly stowed and was escorted into Plymouth harbor. No charges were brought, however, and the trawler was released with a warning.

British fishermen had been complaining in recent weeks that East European

fishing fleets were allegedly hampering their mackerel-fishing operations. Patrols by fishery protection vessels were intensified along the coast of Cornwall according to W. H. Williams, Inspector of Fisheries for the Southwest District.

Mexican Congress Considers 200-Mile EEZ

President Luis Echeverría sent two messages to the Mexican Congress on 5 November 1975 aimed at bringing into law the 200-mile Exclusive Economic Zone (EEZ)[1]. The Presidential messages requested the amendment of Article 27 of the Mexican Constitution[2] and the approval of specific Federal regulations to implement the amendment.

The proposed Constitutional Amendment establishes Mexican "rights of sovereignty" and jurisdiction over an EEZ extending 200 nautical miles from the coastal baselines now used to measure territorial waters, except that, off the Yucatan Peninsula, the borders of the EEZ will be determined by agreements with interested states such as Honduras and Cuba.

After Congressional approval and ratification by a majority of Mexico's state legislatures, the amendment will take effect 120 days following its publication in the *Diario Oficial de la Federación* (Federal Register).

The proposed enabling regulations repeat the terms of the Constitutional Amendment and then stipulate the following: 1) Islands which are part of Mexico, except those which are uninhabited or cannot sustain economic activity, will have their own 200-mile EEZ; 2) Within this 200-mile EEZ, Mexico will have a) sovereign rights to exploit, conserve, and administer both, renewable and non-renewable resources in the subsoil and adjacent waters, b) exclusive rights and jurisdiction over the establishment of artificial islands, installations, and other structures, c) exclusive jurisdiction with respect to other activities related to exploration and economic exploitation of the EEZ, d) jurisdiction over the preservation of the marine environment (including control and elimination of pollution) and scientific research; 3) Foreign states will enjoy rights of navigation, overflight, the laying of submarine cables and pipelines as well as other internationally lawful uses of the sea related to navigation and communication; 4) The Mexican Government will establish catch limits to ensure that living resources are not over-exploited; 5) The Mexican Government will promote the optimum use of living resources within the EEZ. If the total permissible catch of a species exceeds the capacity of the national fishing fleet, the Mexican Government will permit foreign fleets to harvest the difference; 6) These regulations do not modify Mexico's present Continental Shelf regime; 7) Current Mexican Federal laws will apply to all the above areas of jurisdiction until specific new laws are issued. The regulations will take effect 120 days following publication in the *Diario Oficial de la Federación.*

At a joint press conference following the signing of the Presidential message to Congress, the Secretaries of Foreign Affairs, Industry and Commerce, the Navy, and the Acting Secretary of National Patrimony discussed the implications of the 200-mile EEZ in their particular fields. Foreign Secretary Emilio Rabasa called it one of the most important acts in Mexico's diplomatic history, noting that it was "in a sense a revindication by Mexico for the territorial dismemberment which it had unfortunately and unjustly suffered in the past." Rabasa added that "we will now have a Mexico twice as large as today's." The Foreign Secretary stressed that the measure was in accordance with the Law of the Sea agreements already reached at Geneva and Caracas[3], and expressed hope that many other countries would take similar steps.

The Secretary of Industry and Commerce[4], José Campillo Sainz, said that by conservative estimates, Mexico's fishery landings, which now amount to "about a half-million tons" per year[5], should at least triple under the 200-mile regime.

Acting Patrimony Secretary Rafoull said that in addition to petroleum, Mexico would be able to exploit such other minerals in the seabed and subsoil of the EEZ as phosphoric rock, titanium, nickel, and sulfur.

The NMFS Office of International Fisheries reports that there is nothing new in the Presidential messages and legislative proposals, nor is there any significant departure from President Echeverría's August 1975 decision. The language in Article 27 makes it clear that Mexico expects to negotiate differences on overlapping 200-mile jurisdictions, once its neighbors make similar maritime claims. While obviously reserving first claim on fisheries to Mexican nationals, the proposed regulations make it clear that Mexico intends to exploit its marine resources fully and will afford foreign fishermen the opportunity to catch the amount of fish which Mexicans do not presently have the capability to harvest. It should also be noted that nothing in the procedures chosen by President Echeverría implies sudden, arbitrary action, since the legislative process and ratification will take at least some weeks and the laws will not take effect for another four months after that process is completed. (Source: U.S. Embassy, Mexico City, 6 November 1975.)

[1]The 200-mile EEZ was first announced 5 August 1975 in Alexandria, Egypt by the Mexican Foreign Secretary.

[2]Article 27 vests ultimate ownership of Mexico's lands and waters in the State and asserts its control over their use.

[3]Some passages in the proposed enabling legislation are either quoted or quite similar to Part II of the Informal Single Negotiating Text presented to the Third U.N. Conference on the Law of the Sea (LOS); however, it should be pointed out that the text is a working document which has not been approved by the countries involved in LOS negotiations.

[4]The Mexican Fisheries Administration is a subsecretariat in the Secretariat of Industry and Commerce.

[5]Mexico reported total fishery landings of 390,000 metric tons in 1974. Considering the large number of new vessels now under construction, landings may increase significantly in the next few years.

Fishery Notes

Alaska Expects Best Salmon Haul Since 1971

The Alaska Department of Fish and Game is predicting a statewide commercial salmon harvest of 37.8 million fish in 1976. If realized, the catch would be an increase of about 12 million over last year and the highest since 1971. Steve Pennoyer, senior research biologist for the department, told the Board of Fisheries' December meeting in Juneau that while the fisheries are still suffering from the effects of the severe winters of 1970-1971 and 1971-1972,

improvements in a number of areas are possible this coming season.

Pennoyer cited the pink salmon fishery at Kodiak and the pink and chum salmon runs in Prince William Sound as examples of fisheries showing strong recovery because of adequate escapement and good streambed survival. The Prince William Sound forecast, for example, projects an allowable harvest of 5.2 million pink salmon and a chum harvest of 2.8 million. Even if the 1976 chum run is in the lower part of the forecast range, it will still be the largest on record for the Prince William Sound area. The Department of Fish and Game is also predicting a harvest of about 10.1 million pink salmon in the Kodiak area out of a run that could total about 12.9 million fish. Fishers harvested about 2.9 million pinks at Kodiak in 1975.

The forecasts predict harvestable returns of sockeye salmon in all Bristol Bay systems except the Snake River. A harvest of about 5.1 million fish should be possible out of the projected sockeye run of 12 million. Nushagak district pink salmon harvests are expected to total about 2.2 million fish. A small pink salmon harvest is expected in southern Cook Inlet and the Chignik fishery probably will be limited. Extremely low pink salmon runs are expected in Southeastern Alaska with virtually no harvests expected.

A total run of 5.6 million pinks is predicted for Southeastern Alaska and unless the returns are stronger than expected, all or most of the fish will be needed for escapement, Pennoyer said. Returns of chum, chinook, sockeye and coho salmon are expected to be about average in Southeastern Alaska. "But if the factors which weakened the 1975 runs of chum, sockeye and coho influence the 1976 return, runs of these species could also be less than anticipated," Pennoyer added. The extremely cold winters of 1970-1971 and 1971-1972 are believed to be the major factor causing the currently depressed salmon runs throughout much of Alaska.

Publications

Nicaragua and Brazil List Fishery Books

The Division of International Fisheries Analysis (F41), Office of International Fisheries, NMFS has obtained a 3-page bibliography of the publications issued by the Fisheries Division of the Nicaraguan Development Institute (Instituto de Fomento Nacional, or INFONAC). INFONAC's publications cover the following subjects: Official Nicaraguan fisheries statistics, artisanal fisheries, processing, exports, exploratory fishing, bibliographical data, fleet, gear and methods, and various aspects of the shrimp and lobster industry.

In Brazil, the UNDP/FAO Fisheries Research and Development Program has published a bibliography of its 1973-75 publications (in Portuguese). The 2-page bibliography includes technical documents on fishing methods, fisheries resources and fish processing, as well as studies dealing with various species, such as shrimp, corvina, sardine, lobster, and braise. Copies of either listing may be obtained from Dennis M. Weidner, Office of International Fisheries, F41, NMFS, NOAA, Commerce Department, Washington, DC 20235, and enclose a self-addressed mailing label to facilitate mailing.

Clam Potential Eyed in Alaskan Report

The economic potential of the Alaska clam industry is the subject of a new 148-page report published by the University of Alaska Sea Grant Program in cooperation with the university's Institute of Marine Science. Entitled **The Alaska Clam Fishery: A Survey and Analysis of Economic Potential,** the new report concludes there will be "significant growth" of the Alaskan clam industry if certain events occur.

These events are: 1) Alaska's obtaining and maintaining membership in the National Shellfish Sanitation Program; 2) introduction of environmentally safe clam dredges; and 3) devotion of more resources to clam source beach certification and monitoring; and transferring of harvesting efforts for bait razor clams (used in dungeness crab fishing) to non-certified beaches.

"Given the probable occurrence of these events, it is not unrealistic to expect annual harvests of around five million pounds shell weight within the next decade," says the report. "The value to the fishers of such a harvest will likely be in excess of $2 million."

The report—containing sections on history, regulation, harvesting, processing and marketing—was written by Franklin L. Orth, associate professor of economics; Howard M. Feder, professor of marine science; and John Williams, assistant professor of seafood science. All are with the University of Alaska. Another coauthor, Charles Smelcer, is with the U.S. Army. Copies of the report can be obtained by writing the Alaska Sea Grant Program, University of Alaska, Fairbanks, Alaska 99701.

Marine Geophysical Data Catalog—1975 Available

NOAA Environmental Data Service's National Geophysical and Solar-Terrestrial Data Center has released **Marine Geophysical Data Catalog—1975, Key to Geophysical Records Documentation No. 4,** which includes all bathymetric, magnetic, gravimetric, seismic profile, and navigation information available from the Center. It also indicates types of data formats, identifies specific cruises or surveys, depicts geographical distribution of the data by area index charts, and includes a trackline sketch for each cruise or survey.

The 1975 catalog updates and supersedes "Key to Geophysical Records Documentation No. 1" (published in June 1972), and includes 58 marine geophysical data sets that have become available since 1972. It also gives availability of complementary data, including map plots, charts, etc. A pocket insert map, "Multitrackline Plots," includes bathymetric, magnetic, gravimetric, and seismic reflection data collected worldwide along 2¼ million nautical miles of tracklines.

Further information about the catalog and available data may be obtained from: Solid Earth Data Services Division (D62), National Geophysical and

Solar-Terrestrial Data Center, Environmental Data Service, National Oceanic and Atmospheric Administration, Boulder, CO 80302. The catalog may be purchased from: Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402 for $5.25 (Stock No. 003-017-00292).

In Brief . . . .

Fishery Development, Catches, and Values

. . . .**The International Oceanographic Foundation's 1975 Gold Medal Award** has been presented to Melville Bell Grosvenor "for his personal endeavors and support of the advancement of the scientific study of the oceans . . ." Grosvenor, Editor in Chief of *National Geographic* and Chairman of the Board of the National Geographic Society . . . .

. . . .**Alfred M. Beeton, associate dean for research administration** at the Graduate School, University of Wisconsin—Milwaukee, will become director of the Great Lakes and Marine Waters Center at the University of Michigan on 1 July 1976, the University of Michigan reports. Before joining the UW faculty, Beeton was chief of the Environmental Research Program at the Ann Arbor Biological Laboratory of the U.S. Fish and Wildlife Service . . . .

. . . .**The Solomon Islands has begun to develop its fisheries industry** to make it self-sufficient in fish by 1978 and then build an export market, *Australian Fisheries* reports. The Solomon Islands now has a live-bait skipjack tuna fishery which produced 11,000 tons of fish in 1974. Under study are projects on rock lobster stocks, offshore resources, fish smoking and preservation techniques, fish meal production, squid, etc. . . .

. . . . **The value of Australia's fish, crustacean, and mollusk production** in 1973-74 was more than A$100 million for the first time, according to an Australian Bureau of Statistics report in *Australian Fisheries*. The rock lobster fishery remained most valuable at a value of over $30 million, closely followed by the prawn fishery at $29 million. The wet fish catch was valued at $26 million, up $3 million from 1972-73. Tuna was the top fish in both weight, 9,700 metric tons, and in value, $3.6 million. Western Australia, with fish production valued at $25 million, was the leading fishing state, followed by New South Wales, $21 million, South Australia, $17 million, Queensland, $14 million, Victoria, $11 million, and Tasmania, $8 million. . . .

. . . .**Norman Doelling has been named manager of the Massachusetts** Institute of Technology Sea Grant Program's Marine Industry Advisory Service, a new link to exchange ideas and information on marine business opportunities with industry. A main component, the Marine Industry Collegium, will keep participating businesses abreast of the latest opportunities in utilization of chitin and chitosan, farming and use of kelp as an energy source, conversion of waste water and sewage sludge into a resource, and others. . . .

. . . .**Hatchery-reared trout and salmon released in the Great Lakes** and lower courses of tributary streams in 1975 totalled about 22.2 million, according to a report in *The Great Lakes Newsletter*. Total 1974 plantings were over 24 million fish. Principal species planted last year were chinook (7 million), coho salmon (4.7 million), and lake trout (6.5 million)—18.2 million altogether versus 18.4 million in 1974. Since the start of the lake trout restoration program in 1958, over 66 million young fish have been released in the Great Lakes. About 2.1 million steelhead trout, and 1.1 million brown trout were planted, as were lesser numbers of splake, brook trout, and Atlantic salmon. . . .

. . . .**A remote, underwater fish-tracking system** to test the reaction of migrating fish to pollutants from known point sources is being jointly developed by the Langley Research Center of the National Aeronautics and Space Administration (NASA) and the Virginia Institute of Marine Science (VIMS), according to a VIMS news release. Underwater listening stations pick up sonic signals from tiny fish-tag sized transmitters attached to the fish. Data is transmitted to a base station and relayed to a computer which sorts the information and plots the fish's position as it migrates through the study area. Any change in migratory behavior as the fish enters the polluted area—such as slowing, swimming around it, or turning back—will be detected. . . .

. . . .**Ownership of the R/V *Hernan Cortez* has been officially placed** with the Marine Research Laboratory of Florida's Department of Natural Resources, according to the *Florida Conservation News*. Built in 1964 by Desco Marine[1], the vessel was loaned by that company to the DNR for fisheries research work. One of its major efforts was Project Hourglass, a 28-month systematic biological sampling program on the west coast of Florida. More recently, it has been involved in a search for commercial clam beds on the west coast of Florida, a 2½-year study of rock shrimp off Cape Canaveral, and other cruises. It is now being used in the Gulf of Mexico in an effort to detect red tides from satellites. . . .

[1]Mention of trade or commercial names does not imply endorsement by the National Marine Fisheries Service, NOAA.

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